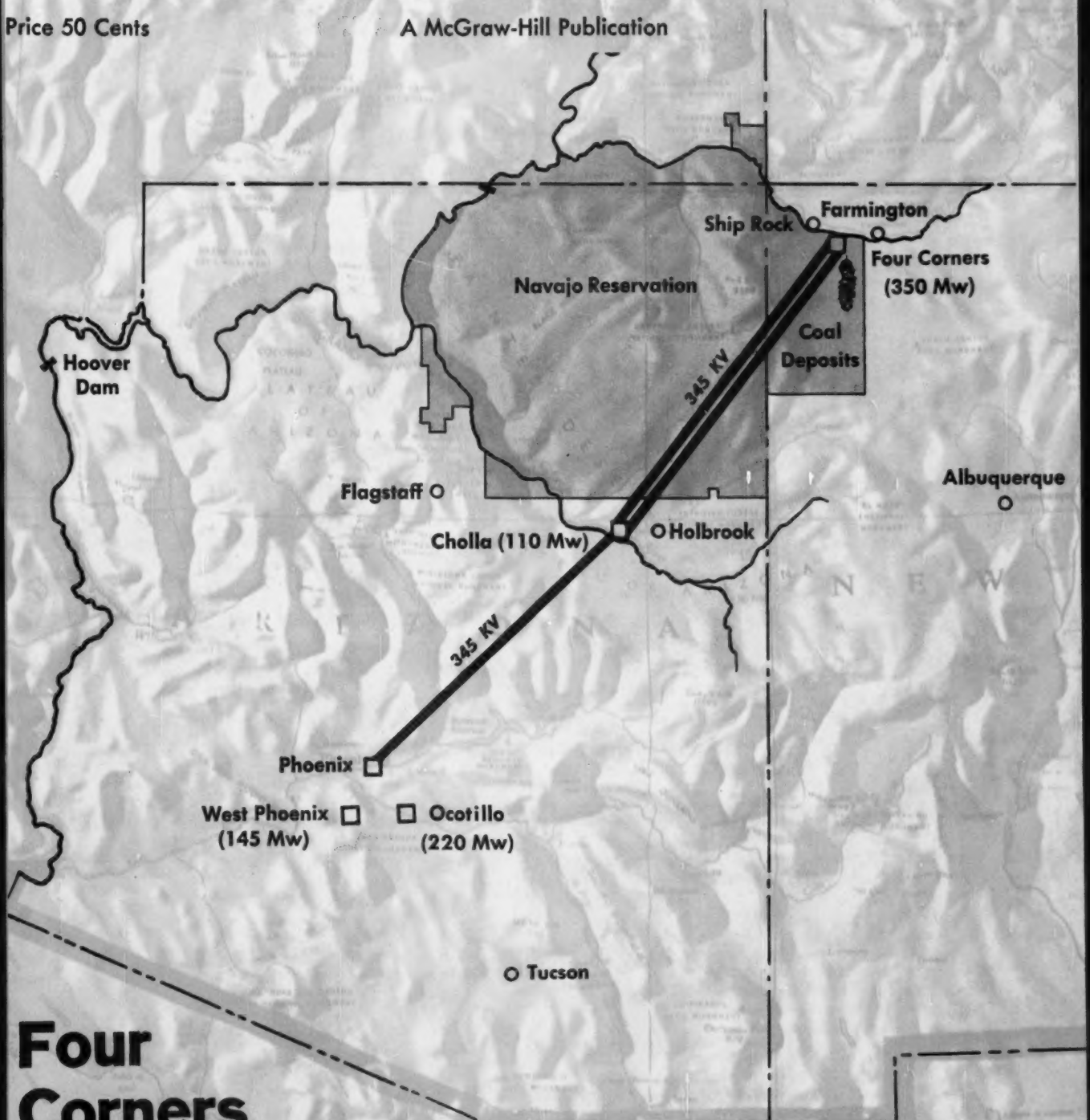
The Electrical Industry's Weekly Magazine July 24, 1961

Electrical World

Price 50 Cents

A McGraw-Hill Publication



Four Corners Taps Navajo Coal

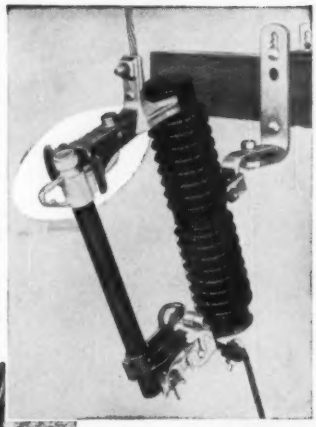
...page 30

UNIV MICROFILMS INC
EDITORIAL DEPT
313 N FIRST ST
ANN ARBOR MICH

"FOLLOW-ACTION" CONTACTS

OF KEARNEY "GX" CUTOUTS

...eliminate danger of external arcing
...prevent recoil damage



KEARNEY

"FOLLOW-ACTION"

LOCKS CONTACTS CLOSED UNTIL FAULT IS INTERRUPTED

Stainless steel springs in the top contact assembly of the Kearney GX cutout, absorb shock... and by "following" any motion of the cartridge created by recoil impact, keep the top contacts firmly locked together under high pressure until the fault has been interrupted. Contacts cannot separate during interruption to cause external arcing or contact burning.

Ball and socket contacts are self-aligning, cannot be bent or twisted out of alignment by severe faults, and always seat properly regardless of the angle of cartridge close-in. Dependable, safe operation is assured.

Balanced Double Venting . . . prevents recoil damage. Expendable cap blows on high faults. Expulsion gases discharge from both ends of the GX cartridge to equalize pressure and neutralize recoil shock. At the same time, relief of excess pressure within the cartridge prevents tube bursting. On low amp faults, the GX cartridge single-vents from the bottom only, assuring ample gas pressure for positive interruption.

Cast Bronze Hood . . . prolongs cutout and contact life by protecting top "follow-action" contacts from severe weather and ice. Hood also shields contacts from dirt and corrosive elements, providing added insurance of dependability and long life. Extra-wide entry jaws guide cartridge securely into contacts even at awkward close-in angles.

Contact your Kearney Sales Representative or write for Bulletin 1A.

for better construction... safer maintenance... specify KEARNEY products

KEARNEY

JAMES R. KEARNEY CORPORATION

4224-42 Clayton Avenue • St. Louis 10, Missouri

812

PLANTS AT: ST. LOUIS • MELROSE PARK, ILLINOIS • FAYETTEVILLE, ARKANSAS • GUELPH, ONTARIO, CANADA • ST. THERESE, QUEBEC, CANADA

Published for 87 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

July 24, 1961
Vol. 156, No. 4

Dateline . . .

Was President Duped on TVA Rate Boast?

Washington, D. C.—The news services and newspapers around the country carried stories datelined July 11 from Washington indicating that federal power had scored another triumph, bringing lower electric rates to those consumers in the TVA area. Even the *New York Times* put the story on the front page and devoted a full column to it. The implication was clear that TVA was lowering its rates.

The story had originated at the White House with President Kennedy standing by and nodding approval as members of the TVA board disclosed rate decreases in their area. An official release, prepared for the occasion by Doremus & Co, public relations counselors in New York, was made available for the hapless reporters who couldn't make the White House ceremony.

The Doremus & Co release opened, "The board of directors of the Tennessee Valley Authority announced today the availability of a new and lower electric power rate for residential, farm, and commercial users."

White House reporters went off to file the stories clearly indicating that TVA was cutting its rates.

Those few who wanted to dig deeper for the facts would have been amazed to find that:

- TVA did not reduce its rates in any manner whatsoever. Its own rates to every one of its customers remain the very same as they were before the widely heralded White House announcement.
- TVA's only action was to permit two of its utility customers to charge less for the electricity they sell to ultimate residential and commercial customers. These two utilities serve a mere 4.3% of the residential consumers and 5.4% of the commercial consumers in the Tennessee Valley area.
- The rate change reflects no glory on TVA or on federally produced power. Any credit must go to the two relatively small utilities that did cut their rates with TVA permission.

In effect, President Kennedy let the White House be used to announce relatively small rate reductions by a rural electric cooperative in Mississippi and a municipally-owned system in Alabama.

(*Continued on page 5*)

Publisher Warren W Shew
Editor Charles F Hochgesang
Senior Editors Daniel T Braymer, Leonard M Olmsted, Jesse A Mock
Managing Editor Herbert R Frankel

ENGINEERING

Southeastern Editor Edward Allen, Atlanta
Midwestern Editor Francis J Kovalcik, Chicago
Western Editor Paul H Leech, San Francisco
New England Editor Howard S Knowlton, Boston
Middle Eastern Editor Bruno Zambotti
Northeastern Editor Willard L Felsen
Methods Editor Michael G McGraw
Associate Editor George Swift
Overseas Correspondent J H M Sykes, London
Consulting Editor Archer E Knowlton

NEWS

News Editor Dale VanHorn
Associate Editor Leon A Allen, Jr
Supply Lines Editor Paul F Roman
Assistant Editor William P Kennedy
Washington Correspondent N Burkey Musselman

ART & PRODUCTION

Art Director Frank C Stockman
Assistant Art Director Pressly Donald
Assistant Editor Steven Ludwig
Editorial Assistant Earl J Carter

Mfrs News Editor Michael G McGraw
Assistant Editor Elizabeth R Parker

Mgr, Mkt Research Arthur J Stegeman

Commercial Editor John D Damon

ADVERTISING

Sales Manager Walter R Klein

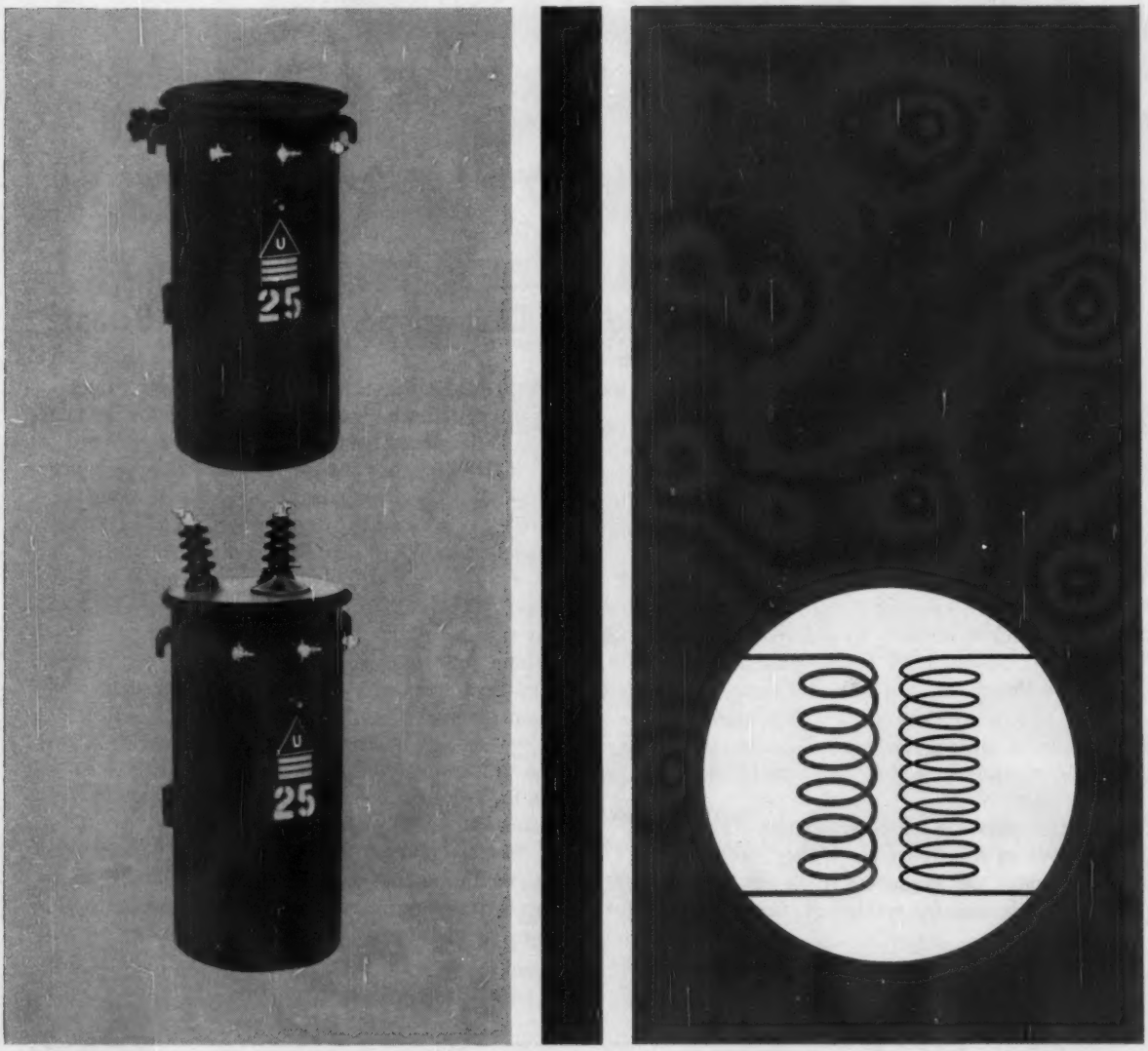
District Managers E B Sessions, J B Roll, Jr, New York; D L Roberts, Boston; E A Martin, Philadelphia; E F Coffey, Jr, Cleveland; E F Coffey, Jr, Detroit; M S Kearney, Pittsburgh; W H Meneilley, J T Schaefer, Chicago; J T Schaefer, St. Louis; Robert Yocom, Los Angeles; T H Carmody, John Hernan, San Francisco; Robert H Powell, Atlanta; John Grant, Dallas; D O Hanson, Houston; John Patten, Denver; Scott Hubbard, Portland, Ore.

Business Manager Otto A Drechsel
Asst Business Mgr John F Dugan

Promotion Manager Donald K Ellis

Circulation Manager S A La Faso

UPTEGRAFF U-65 TRANSFORMERS • BUILT FOR 65°C TEMPERATURE RISE • STANDARD NEMA RATINGS



U-65 PROVEN!

UPTEGRAFF U-65 TRANSFORMERS MEET YOUR MOST SIGNIFICANT TEST/ECONOMY

ECONOMICAL IN OPERATION due to lower loss ratio, lower voltage drop at peak load, and high efficiency. In evaluation studies, the economical performance of the radically new U-65 is proven. **ECONOMICAL IN PRICE,** because the compact design of the U-65 requires less copper, steel, oil and other materials than conventional designs. Consequently, prices to the purchaser are considerably lower. **ECONOMICAL IN SERVICE,** because the tremendous thermal endurance of new high-temperature insulating materials assures long life.

Uptegraff U-65 transformers meet your most significant test—**ECONOMY!**

R. E. UPTEGRAFF MANUFACTURING COMPANY

Scottdale, Pennsylvania • Representatives in Principal Cities
Member National Electrical Manufacturers' Association

U TRANSFORMERS

Electrical World

Dateline . . .

Washington, D. C. (*Continued from page* 3)

To the credit of the *New York Times,* it must be said that this widely respected newspaper sought to put the story in perspective with a front page article two days later that characterized the rate cut announcement as a "stunt."

In a neat job of tailoring its story to its audience, Doremus & Co released another version of the TVA rate announcement for New York underwriters next day assuring them that the rate change "in no way affects the wholesale rate at which TVA sells electricity to the local distributors in its region . . ." This release went on to say that the retail rate would have no adverse effect on TVA's power revenues and that its only effect would be to enable those distributing systems with lower operating costs to pass on these savings to ultimate customers.

TVA's wholesale rate had not even been mentioned in the glowing release at the White House.

A spokesman for Kentucky Utilities Co came nearest characterizing the significance of the White House announcement. Said the KU spokesman: This action "was about the same as if an individual General Motors car dealer cut his prices by $100 and the car maker decided to take full credit for the 'price cut.' "

There is some doubt whether President Kennedy realizes even yet that his office was used to foster a misleading story about TVA rates. It may be that TVA executives did not fully appreciate the interpretation that would be given their statement.

It may be conjectured that this announcement praising federal power and the accompanying endorsement by President Kennedy was timed to create the proper atmosphere for the House vote next day on the Hanford reactor power facility.

If that was the purpose, it failed. The House next day voted 176 to 140 to knock out the federal power generation facilities for the Hanford reactor.

Letters

A Glowing Ode—To an Order

To the Editor:

I am pleased to enclose my personal philosophy with regard to that most important entity to any business, namely, the customer:

An order is a thing of beauty and a joy forever—to the receiver. It is the Alpha and the Omega upon which our continued existence in the business community depends.

An order is next month's payment on the home we are buying, or Junior's college tuition. It is the invisible badge of achievement the engineer, the salesman, the machine worker and, yes, the president and the board chairman wear, dignifying and enriching each to his own as his right to human dignity thus earned.

But an order is much more than these things. It is a testament to others to their faith in us and our ability to perform cheerfully and in competence the happy burden of proof imposed upon us by his order. In short, an order is the elixir of life upon which we feed, literally as individuals and collectively and economically as a group of individuals who have banded together in a common cause of performance.

If we, each of us, can help to expedite the smooth and rapid flow of an order through the Alice-in-Wonderlandish red tape entrapments of paperwork and human distractions imposed by our modern age of machines that think, only to create more and more paperwork for more machines to do; then it is conceivable that an order may properly reach the hands of production and shipping which is the shortest distance between an invoice, and the faith of our customer in us will have been justified.

And, in the end, more of us may come to know that an order is our only excuse for being.

Because our competition knows these things, of that we all may be sure!!!

Kenneth R. Miller
Western Sales Manager
Preformed Line Products Co
Palo Alto, Calif.

Address correspondence to Letters Editor, Electrical World, 330 W 42nd St, New York 36, N. Y.

ELECTRICAL WORLD
Vol. 156, No. 4 July 24, 1961

Published weekly by McGraw-Hill Publishing Co., Inc., James H. McGraw (1860-1948), Founder. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Printed in Albany, N. Y.

Officers of the Publications Division: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. Officers of the Corporation: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Secretary.

Subscriptions are solicited from executive supervisory, and engineering personnel in electric utilities, manufacturing companies, and related fields; and from consulting engineers and electrical engineers in industry. Position and company connection must be indicated on subscription orders. ELECTRICAL WORLD is available only by paid subscription. Publisher reserves the right to refuse non-qualified subscriptions. Please send to the address shown in the box below.

United States and possessions subscription rate for individuals in the field of the publication $6.00 per year; Canada $7.00; single copies 50 cents. Other Western Hemisphere and the Philippines $20.00 payable in advance and other countries $30.00 payable in advance.

Second-class postage paid at Albany, N. Y. Title ® registered in U. S. Patent Office. © Copyright 1961, McGraw-Hill Publishing Co., Inc. All rights reserved. Permission required to reproduce any of contents.

Unconditional guarantee: On written request from any subscriber, the publisher agrees to refund the unused portion of the subscription price if editorial service is unsatisfactory.

SUBSCRIPTION AND ADDRESS CHANGES: Send subscription correspondence and change of address to Fulfillment Manager, ELECTRICAL WORLD, 330 West 42nd Street, New York 36, N. Y. Change of address notices should be sent promptly; provide old as well as new address; include postal zone number, if any. If possible, attach address label from a recent issue. Please allow one month for change to become effective.

Postmaster . . . Please send form 3579 to Electrical World, 330 W. 42nd St., New York 36, N Y

Exclusive Lapp Process Stabilizes Power Factor and Loss in Post Insulators

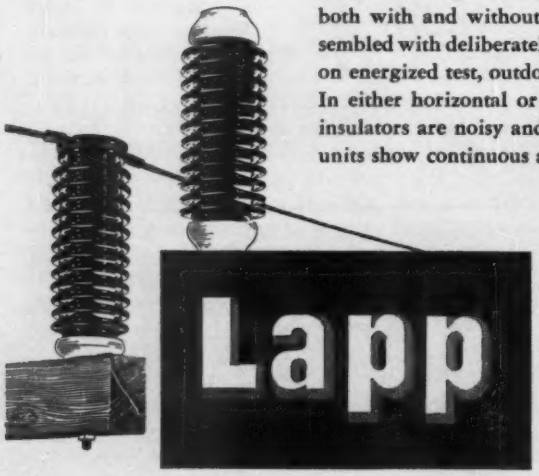
A LAPP LABORATORY REPORT

THE PROBLEM: Line Post and Station Post insulators occasionally have been found to show variation in power factor, charging current and watts loss under Doble tests. Field service seems not to have been impaired, but the phenomenon has been noticeable in such instances as erratic readings secured in tests of bushings connected to Post insulators.

THE FINDING: Some years ago engineers of the Lapp Laboratory staff were assigned the job of tracing down the cause of such variations. It was located and identified as contamination deposits on the inside walls of the insulators. Porcelain bodies for Lapp Post insulators are subjected to a severe test for electrical soundness—a 3-minute flashover from the inside of the head around the body to the outside of the head. During this test the hole in the insulator fills with corona, and contaminating particles deposit on the walls of the hole; amount of this deposit and its effect on electrical characteristics vary with atmospheric conditions at the time of the test and at the time of plugging the hole for assembly.

THE SOLUTION: A thin coating of silicone applied to the wall of the insulator hole negates the effect of the corona contamination, and results in insulators dependably uniform in power factor, charging current and watts loss. Permanent effectiveness of the silicone coating is assured by its inherent chemical stability, and by the fact that the hole to which it is applied is sealed by the Lapp plug against weather, light, heat, or other physical or electrical attack. A Lapp patent is pending on the process.

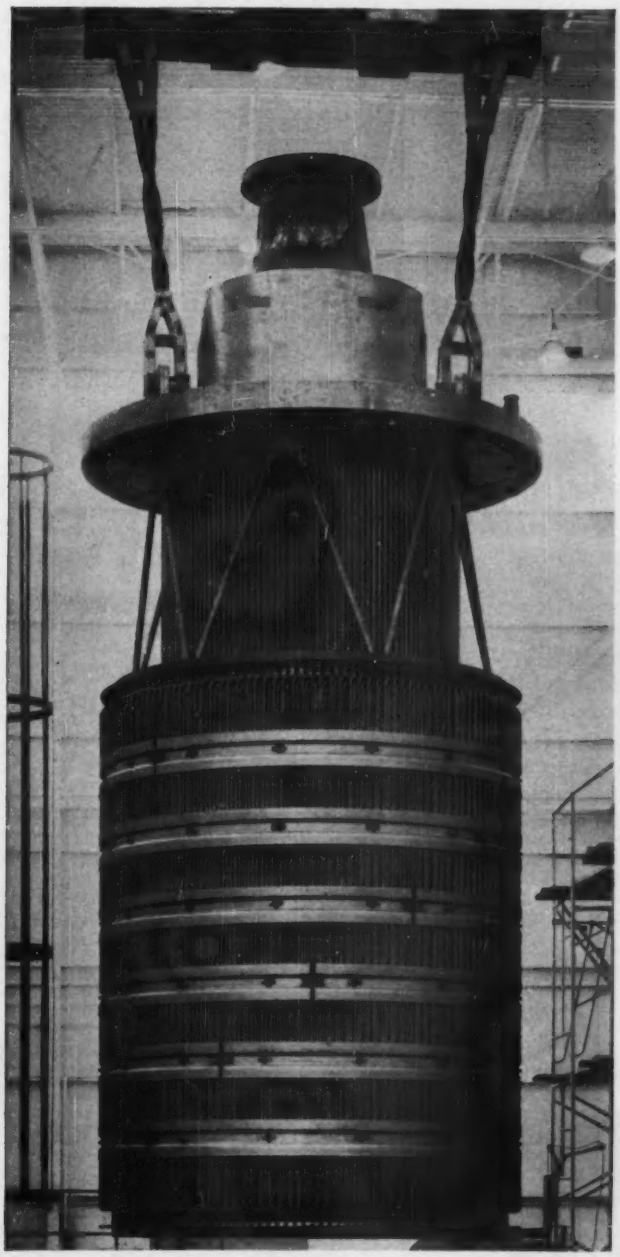
THE VERIFICATION: All Lapp Line Post and Station Post insulator production for more than three years has incorporated the silicone treatment. The low initial power factor of the insulator has been maintained on every unit re-tested after service. In addition, in an effort to determine limits of effectiveness of the process, a series of insulators has been set up in the Lapp laboratory. Post insulators, both with and without the silicone treatment, were assembled with deliberately-defective plugs. They have been on energized test, outdoors, continuously for three years. In either horizontal or vertical mounting, all untreated insulators are noisy and show high loss. Silicone-treated units show continuous and unchanging low loss.



THE CONCLUSION: To the widely-known advantages, in electrical and physical performance, of its Post insulators, Lapp research has added the characteristic of stability in power factor, charging current and watts loss. *At Lapp, insulator design and production is a matter of continuous development and improvement.*

Lapp Insulator Co., Inc., Le Roy, N. Y.

TOMORROW'S POWER



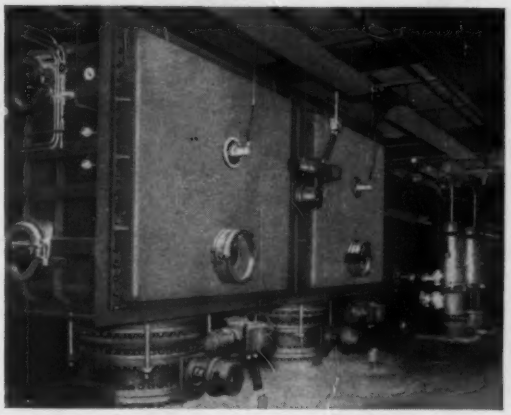
and

C. H. WHEELER / GRISCOM-RUSSELL

COMBINED INGENUITY

AND SKILL BUILT IT.

Three identical Griscom-Russell Vertical Once-Through Involute Tube, Liquid Sodium Heated Steam Generators (one of which is shown here)—have been installed and are being tested at the Enrico Fermi Power Plant built by the Power Reactor Development Corporation. These generators—first of their kind ever built—are an important break-through in the continuing efforts to produce steam from nuclear power more economically.



This 50,000 sq. ft. C. H. Wheeler Condenser at the new Indian River Plant of the Orlando (Florida) Utilities Commission, serves the 78,500 (rated capacity) turbine-generator. Its special deaerating features saved money in installation costs. C. H. Wheeler Ejectors, Circulators and the Condensate Pumps shown at the right also serve this new plant.

GRISCOM-RUSSELL / **C. H. WHEELER**

Massillon, Ohio — Philadelphia 32, Pa.

From this combined source you may now select condensers, circulating, condensate and general service pumps, steam jet ejectors, feedwater heaters, evaporators, generator gas coolers, tank heaters, heat exchangers, or special steam generators . . . all engineered and coordinated to meet the performance and space requirements of your power station.

design

simplicity

KPF switches are simple and functional in design. This insures a clean, attractive pole top whether phase units are installed in a triangular, vertical or horizontal configuration.

The simple design of KPF switches also assures operating dependability under all weather conditions. KPF switches have no delicate mechanisms to malfunction, freeze, lock, need lubrication or wear out.

KPF switches have proved themselves in almost 50 years of service on major utilities. Make a test installation. Discover their unique dependability on your own system.

Install in the air—or on the ground

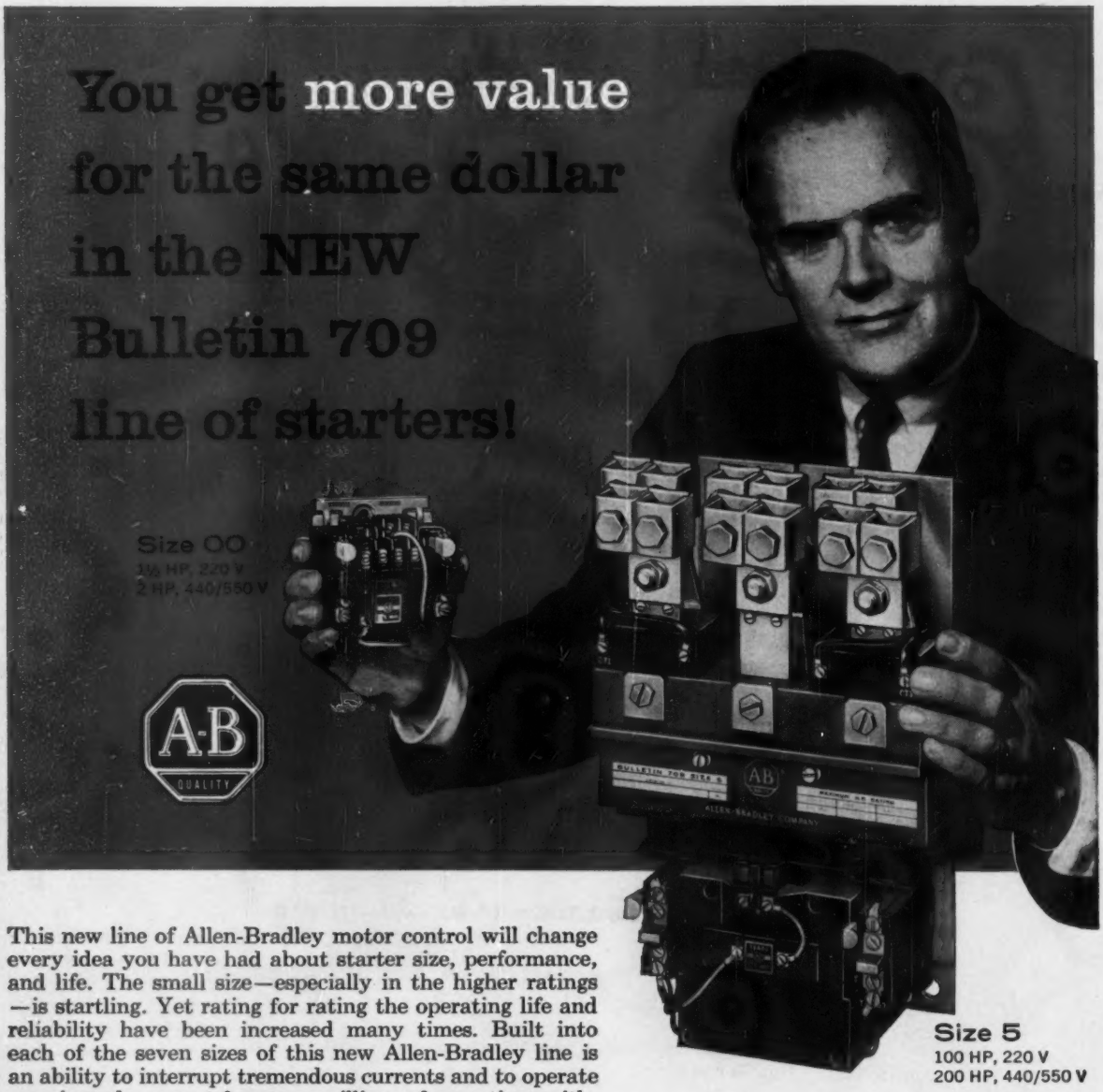
- Top (left)—phase units installed in the air, on previously mounted cross arm.
- Middle—phase units installed on cross arm while on the ground.
- Bottom—phase units and cross arm installed on the ground—pole then tilted into place.

Write direct for catalog

KPF ELECTRIC CO.
P.O. Box 1257E
Stockton, California
HOward 4-8381 • Area Code 209

KPF
AIR BREAK SWITCHES
Standard for nearly half a century

You get more value for the same dollar in the NEW Bulletin 709 line of starters!



Size 5
100 HP, 220 V
200 HP, 440/550 V

Note the compactness of both the smallest and largest starter in the new Bulletin 709 line. Ratings up to 100 hp, 220 v; 200 hp, 440-550 v.

This new line of Allen-Bradley motor control will change every idea you have had about starter size, performance, and life. The small size—especially in the higher ratings—is startling. Yet rating for rating the operating life and reliability have been increased many times. Built into each of the seven sizes of this new Allen-Bradley line is an ability to interrupt tremendous currents and to operate year in and year out for many millions of operations without trouble or maintenance.

The new Bulletin 709 starters are just as advanced in appearance as they are in performance. All seven sizes have an aristocratic styling and a distinctive family likeness. Brooks Stevens, famous industrial designer, has given the enclosures such an attractive, modern style that these new starters will prove a distinct sales asset on any machine or installation.

Why not write today for more information on this revolutionary new line of Allen-Bradley Bulletin 709 *quality* across-the-line motor starters?

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1327 S. First St., Milwaukee 4, Wis.

QUALITY MOTOR CONTROL

Electrical World

JULY 24, 1961
Vol. 156, No. 4

Preview of the Issue

DEPARTMENTS

Editorial Comment..... 23
Dateline 3
Letters 5
Electrical Week..... 12
Supply Lines..... 13
ERS 34
Today's Design Trends... 43
Selling 45
EUM 46
Manufacturers News..... 48
New Equipment..... 50
Management Newsletter. 53
News About People..... 64
Books 68
Advertising Index..... 72

● CONFLICT BETWEEN SENATE APPROVAL and House rejection of Hanford conversion will be resolved in Senate-House conference..... 24

● FOUR CORNERS PLANT RISES IN DESERT near intersection of Arizona, Colorado, Utah, and New Mexico. Coal-fired station being built on Navajo reservation will transmit via 345-kv lines..... 30

● CAPACITOR SWITCH FAILURES ARE ENDED by bonding and grounding. Utility discovered method by duplicating pole-top distribution operating conditions..... 36

CURRENT EVENTS

NRECA PRODS KENNEDY to carry out resources and power campaign pledges..... 27

URANIUM PRICE CUT affects plants: Technological progress is a major factor in advancing nuclear development, with lower fuel costs taking second place..... 28

STUECK DEATH leaves two FPC posts open to non-Democrats . . . State laws should bar 'territorial encroachment,' Clapp declares . . . Co-op is set to join Iowa Power Pool..... 29

REA REPORTS co-ops bought more power than ever before in fiscal '60 . . . Three public power groups file for 50-Mw reactor project..... 62

DATELINE

WAS KENNEDY DUPED on Tennessee Valley Authority's rate-cut boast? It seems the cut was only by two rural co-ops and didn't effect TVA's over-all rates..... 3

ELECTRIC UTILITY METHODS

'PUSH-OUT STICKS' speed reconductoring by spreading energized distribution circuits while new units are installed . . . 'Fly ash' is being tried as a road base..... 46

ENGINEERING REFERENCE SHEET

TREND TOWARD 100-KVAR CAPACITORS suggests use of tank-rupture curves to aid in selecting fuse links for group fusing of these larger units..... 34

MANAGEMENT

COST OF FUEL: Utilities expect fossil-fuel prices to rise by 10% and nuclear-fuel prices to drop by the same percentage. This is the last of a three-part study..... 53

UDALL IS PLEASED with second round of transmission equipment bids; he feels Interior's griping caused reduction in identical bids . . . Tougher antitrust laws are proposed..... 13

MANUFACTURERS NEWS

100-KVAR CAPACITOR IS 'COMPACTED' in weight and size to fit 50-kvar rack..... 48

POLITICS

PRESIDENT'S WATER RESOURCES PROPOSALS to Congress are in line with Kerr recommendations..... 25

CONGRESSIONAL TEST NEARS: Appropriations group considers alternatives for Upper Colorado. Recently released hearing testimony reveals bitterness of debate..... 26

FRYINGPAN PROJECT DEBATE awaits House Rules Committee go-ahead..... 27

TODAY'S DESIGN TRENDS

FLEXIBLE DEMAND REGISTER cuts metering cost by extending registration range with three-dial register and easily converting to any of three demand periods..... 43

NEXT WEEK

LONGEST SINGLE SPAN IN THE EAST is feature of Hudson River crossing.

The Electrical Week

FUTURE NEWS ▶ **A liberalized policy for granting Section 5 loans** will soon be announced by the Rural Electrification Administration. Section 5 provides for loans to co-ops to enable them to assist their customers in installing electric facilities. The basic change will be to double the length of the present repayment period from five to ten years. The new REA bulletin will place a limit of $100,000 on all Section 5 loans, except loans to co-ops for re-lending to industries.

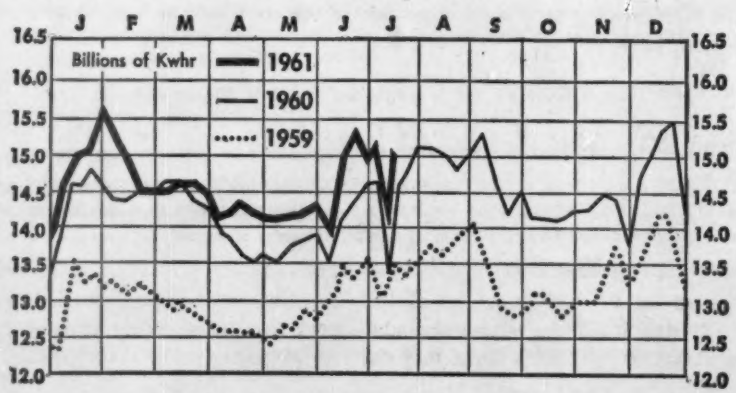
LATE NEWS ▶ **Two utility companies are providing** the President's Committee on Equal Employment Opportunities with the first test cases on how governmental anti-discrimination rules apply in the industry. The Committee is considering a refusal by Houston Lighting & Power Co to sign a Navy contract including the anti-discrimination clause and a plea by Carolina Power & Light Co for special exemption from the rules in contracts to supply Army and Air Force bases. Under the regulations, all utility companies are covered by the orders, which bar discrimination against negroes and other minority groups, in all government contracts over $10,000. However, special exemptions may be made if the Committee approves.

City of Philadelphia files 12 triple-damage suits in US District Court against 17 firms sentenced in price-fixing cases. Suits allege that the city, on behalf of the Philadelphia Gas Works, purchased almost $1.4 million worth of equipment from the 17 firms between 1956 and 1960.

American Gas Assn and General Atomic Division of General Dynamics announce a joint research program to develop a generator to convert gas into electricity. Aim is to develop "a small, low-cost thermo-electric module, which could be used to convert part of the heat from a gas flame directly into small amounts of auxiliary electric power."

A price reduction up to 10% on pole-type distribution transformers was announced by General Electric Co last Friday. The announcement came concurrently with the introduction of a new line of 65C transformers in ratings up to 167 kva, 15 kv and less. The new line supersedes the company's present line of 55C distribution units and will be extended shortly to cover ratings up to 500 kva. This is the company's fifth price reduction in pole-type units to be made since 1957. The price reduction reflects the effect of the 65C design development, the company's preferred size concept and the shift to higher voltages.

WEEKLY POWER OUTPUT—Up 3.2% (Week ending July 15), Kwhr 15,071,000,000



Percent Change From Previous Year

	July 1	July 8	July 15
Total U. S.	+ 3.7	+ 3.4	+ 3.2
New Eng.	+ 4.6	+ 5.6	+ 3.9
Mid. Atlan. ...	+ 2.4	+ 6.9	+ 2.4
Cent. Indust...	+ 5.2	+ 5.7	+ 5.2
West Cent.....	+ 7.7	+13.3	+ 2.7
Southeast	+ 1.2	+ 2.4	+ 1.4
South Cent.	— 4.4	+ 1.8	— 6.8
Rocky Mount...	+10.9	+ 9.6	+ 8.1
Pacific			
NW	+ 5.2	+ 5.0	+ 4.6
SW	+ 9.8	+ 6.8	+12.7

Seasonally Adjusted Index 287
Week Ago 286 Year Ago 279

Source: Edison Electric Institute

Supply Lines

UDALL PLEASED WITH SECOND-ROUND TRANSMISSION EQUIPMENT BIDS

Last May the Interior Department rejected bids on 14 schedules of power transmission equipment because 15 bidders submitted identical prices. About 70% of the bids were identical. New bids on this equipment have been opened, and Interior Secretary Stewart L. Udall said last week that this time around only 17% of the bids received were identical, while prices on some of the re-advertised bids dropped as much as 10%. The Department's squawking about identical bids, Udall feels, has done some good, and he indicated it will still reject them.

Materials involved in this bidding were steel-reinforced aluminum conductors, suspension-type insulators and hardware for suspension assemblies. It will go in the Bureau of Reclamation's transmission lines to be built in the California Central Valley Project and the Colorado River Storage Project.

The principal procurement item in the offering was for the Glen Canyon-Shiprock transmission line in the Colorado Project. "Where before we had received identical bids from all nine bidders, eight bids were received in the new bidding and none was identical," Udall said. "Six of the eight bids also were below the previous identical bid figure in unit cost."

Regulations for the reporting of identical bids received by all federal agencies went into effect this month. The General Services Administration issued the new rules in response to an order from Pres Kennedy, issued last April, establishing government-wide reporting of identical bids to the Justice Dept. The regulations, July 15, apply to federal purchases on sales worth more than $10,000. When a sales invitation brings in identical bids, the agency receiving the bid must furnish a copy of the invitation and an abstract of all bids received to the Attorney General. Identical bids are defined as those which are identical on their face or those which are found to be identical in unit price or total amount.

The regulations are designed to discourage identical bidding, with the hope that government buying costs will be lower, and to provide the Justice Dept with information to assist enforcement of the antitrust laws. The drive against identical bidding is troublesome to both government procurement officers and suppliers. It is based on the assumption that identical bids indicate prices are reached noncompetitively. And, many government officials believe, with more competitive bidding on materials, prices would be lower. The Interior Dept's experience on the re-advertised bids tends to bear this out. But manufacturers contend it is simply the result of list prices being quoted on stock items. Many federal procurement officers claim this practice defeats the purpose of secret bidding on government jobs even though there is no law forbidding it.

TOUGHER ANTITRUST LEGISLATION INTRODUCED IN CONGRESS

New legislation which would stiffen the antitrust laws went into the Congressional hopper last week. Rep Emanuel Celler (D-N. Y.) and Sen Estes Kefauver (D-Tenn.) each introduced four identical bills which would:

1. Increase the fine for violations of the Sherman Act's original provisions to $100,000 from $50,000 and, on a second offense within ten years, up the corporate fine to $500,000 and add a mandatory one-year jail sentence for individuals.

2. Set forth price fixing and division of markets as especially flagrant violations

of the Sherman Act and put penalties for these offenses up to $500,000 for corporations and $100,000 plus a year in jail for individuals.

3. Up the penalty under Section 14 of the Clayton Act for corporation officials involved in price fixing to $100,000 from $50,000 and include within this law any executive who "ratified" an illegal action.

4. Require bidders on government contracts who within the previous two years had submitted identical bids to certify the bids were reached independently. An untrue certification would make the bidder subject to the False Claims Act.

The proposed laws reflect strong reactions by Rep Celler and Sen Kefauver to the Justice Department's far-reaching price fixing charges against the electrical industry. Sen Kefauver feels the present antitrust penalties are not sufficient to cause corporate violators any real worry.

It is significant that in the second bill, which deals specifically with price fixing and division of markets, the language specifies both product and geographical markets. This is a departure from present Sherman Act language which forbids "restraint of trade or commerce among the several states." The definition of this phrase to mean product markets as well as geographic markets was developed in the Bethlehem Steel-Youngstown Sheet & Tube merger case, which the Justice Department successfully attacked in the courts, and has not before been proposed as part of the antitrust laws.

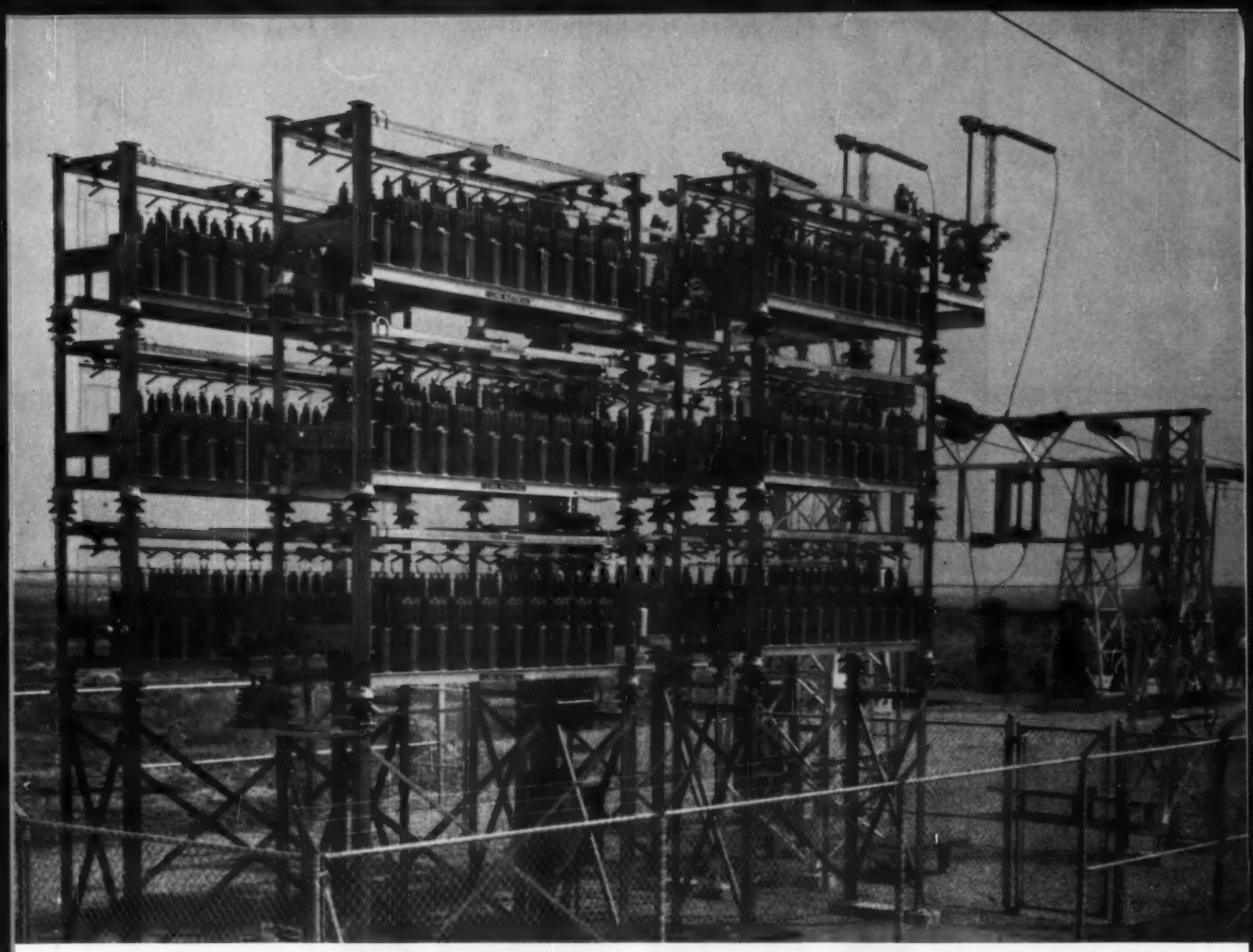
In the third bill, a corporate official is defined as "ratifying" illegal activities when he meets three qualifications: he has knowledge of illegal activities or has reasonable cause to know they are taking place; he has the authority to stop them or has access to a higher official who could stop them; and he fails to exercise this authority. This would overcome one complaint Sen Kefauver has had about the electrical cases: he believes that top corporate officials of the companies should have been punished for antitrust violations by their underlings.

WESTINGHOUSE LINES UP BEHIND NEMA STATEMENT OF PRINCIPLES

Westinghouse officially accepts and endorses the newly formulated NEMA "Statement of Principles." In a letter to NEMA President A. D. R. Fraser, Westinghouse President Mark W. Cresap said, ". . . Westinghouse accepts them (the principles) with the determination to live up to the principles in every respect. We are convinced that by so doing, we shall be advancing the welfare of Westinghouse and of the electrical manufacturing industry." Cresap also urged NEMA to take steps to implement the new code. "With the prompt development of appropriate implementing procedures, which I earnestly urge, and with the announced provision that continued membership is predicted upon acceptance and support of these policies and principles, this total action can be an effective means of assuring the public and our customers of the integrity of our industry," he wrote.

POLE LINE HARDWARE PRICES CHANGED BY JOSLYN

Joslyn republishes pole line hardware prices on a net price basis which will be generally 10% below present prices for Zones 1, 2, and 3 but which will be even lower in some cases to meet competitors' announced prices. Joslyn says it intends to maintain its new prices but may meet more competitive prices and then extend them to all customers.



46 kv, 21,600 kvar step-switched capacitor bank at Utah Power & Light Company's Terminal Substation, Salt Lake City. This bank is step-switched by the L-M Voltage Divider Switching scheme, which utilizes a number of low-cost, 15 kv remote control oil switches, on all but the first step. (Photo by R. J. Norton)

L-M VDS Bank Provides Economical Capacitor Switching for Utah P&L Co.

L-M's Voltage Divider System permits substituting low-cost L-M 15 kv oil switches for other, more costly methods of step-switching large capacitor banks.

Line Material's Voltage Divider Switching method uses L-M's NR 15 kv remote control oil switches on all but the first step. A large number of switches is required, but since they are relatively inexpensive, the total switching cost is far less than with other methods.

Utah Power & Light Company recognized a need for reactive supply when local generation was off and the Salt Lake City load was heavy. The Terminal Substation capacitor bank was installed to supply such power. Use of the L-M VDS system provided a low cost method of switching. The installation accomplished the purpose for which it was designed.

Ask for Technical Paper on VDS

Ask the L-M Field Engineer for information on the L-M VDS method—and for copy of a technical paper on the subject. He will also be glad to tell you about L-M's outstanding line of secondary, industrial, 25, 50 and 100 kvar capacitors; and about L-M's Capacitor Application Engineering Service. Or write Line Material Industries, Milwaukee 1, Wisconsin.

LINE MATERIAL® Industries

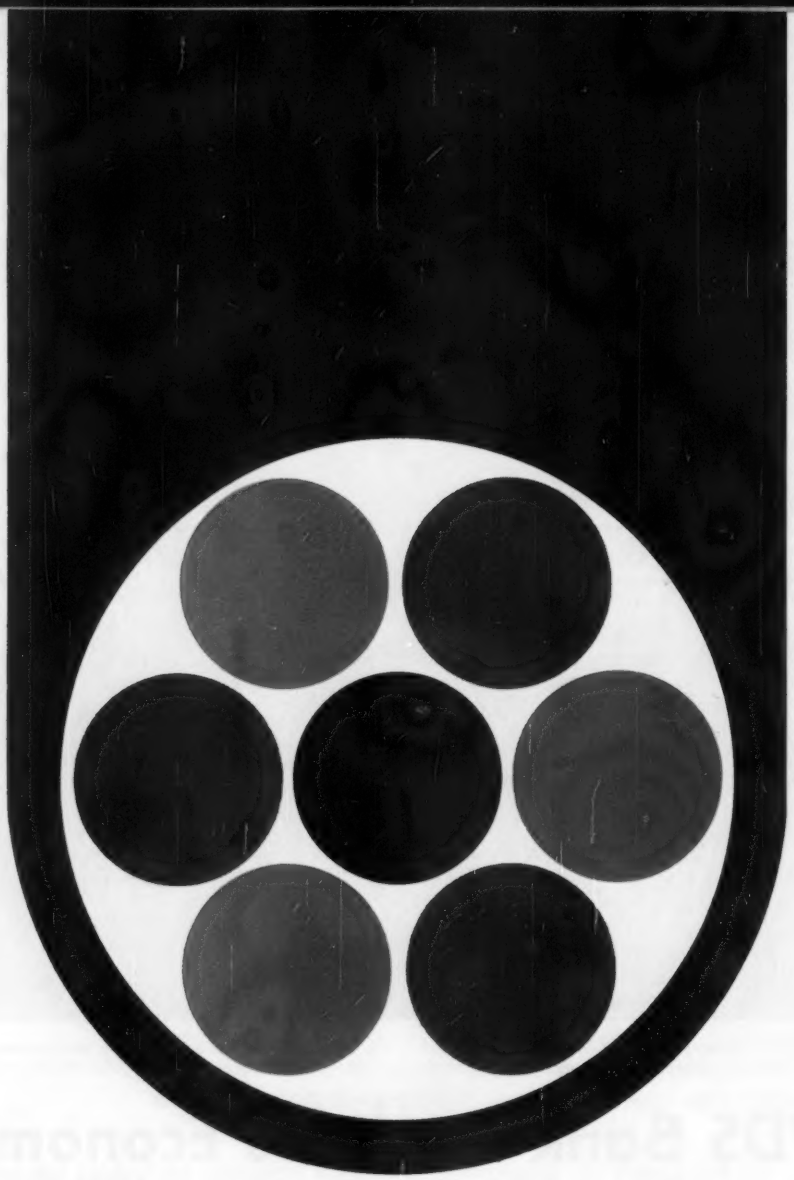
McGRAW-EDISON COMPANY

472

Elemex® Capacitors

McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT



NEW WAY TO EVALUATE CABLE!

"VALUE RATINGS" RELATE PERFORMANCE TO IPCEA OR COMPETITIVE STANDARDS

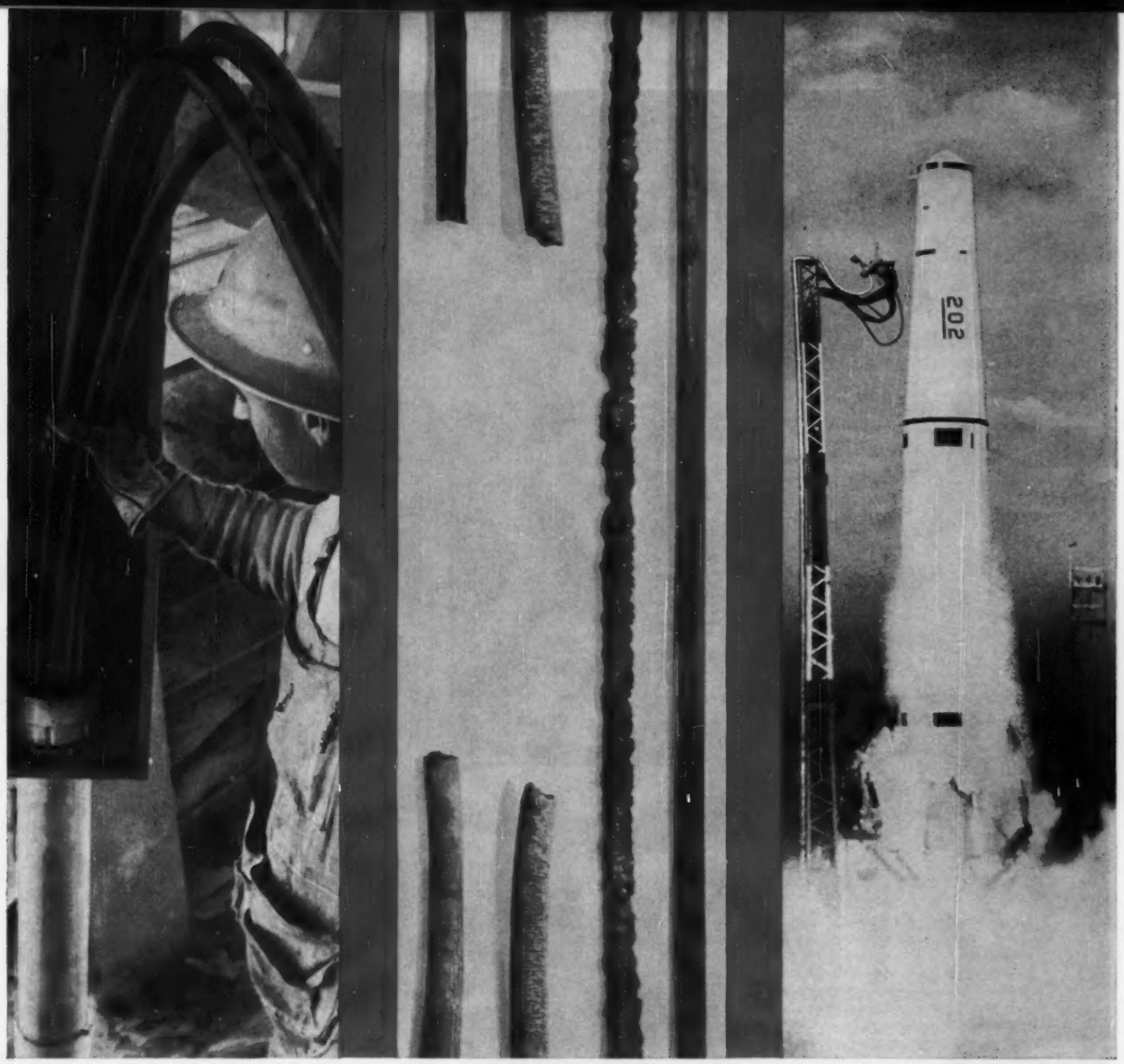
New Value Ratings tell at a glance the composite story of each Kaiser Wire construction—as it performed in as many as 25 specified tests. In each case a well-known standard serves as 100%:

For power cable, the Value Rating standard is all IPCEA test requirements for types of insulation and jacketing specified . . . For portable cord, the standard is service-per-dollar for the least expensive cord (C.V.) as proved by life-expectancy tests. . . . For control cable, the standard is a composite of minimum requirements for eight important insulation qualities.

Compared to these standards, Kaiser Wire constructions earn Value Ratings as large as 767%—valid proof that the spark of quality is Kaiser Wire experience.

For details and Value Rating listings, ask your Kaiser Wire Distributor for free K/W Value Rating Bulletins, or write: Kaiser Wire, Room 844a, Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, California.

KAISER ALUMINUM & CHEMICAL CORPORATION



KAISER GRIZZLY® POWER CABLES PACK RUGGED "DOUBLE PROTECTION"

The insulation and jacketing of K/W Grizzly Spec. 831 power cables deliver more than double the protection required by IPCEA specifications. In ozone resistance, K/W Kalzone® insulation (special butyl compound used in K/W Grizzly cables) exceeds the IPCEA 3-hour minimum by *more than 70 hours*. Typical test values after aging of special K/W Neoprene 10-S jacketing exceed IPCEA minimums by wide margins. Overall comparison against IPCEA tests: 270%—the Value Rating of K/W Cable Spec. 831.

K/W GRIZZLY POWER CABLE SPEC. 831
VALUE 270% RATING

KAISER NEOPRENE 10-S CABLE JACKET RESISTS OZONE LONGEST

The picture above shows competing neoprene jackets that were stretched to twice their original lengths and exposed to .025–.030% ozone. Time: 2 hrs., 23 min. from start. Two have failed. Seven minutes later, the third competitive sample (second from right) failed. The jacket at right—special Neoprene 10-S used on K/W Grizzly power cables—was intact *18 hours later!* Kalzone® insulation of K/W Grizzly cables stood 72 hrs. in similar tests. IPCEA butyl insulation requirement is 3 hours.

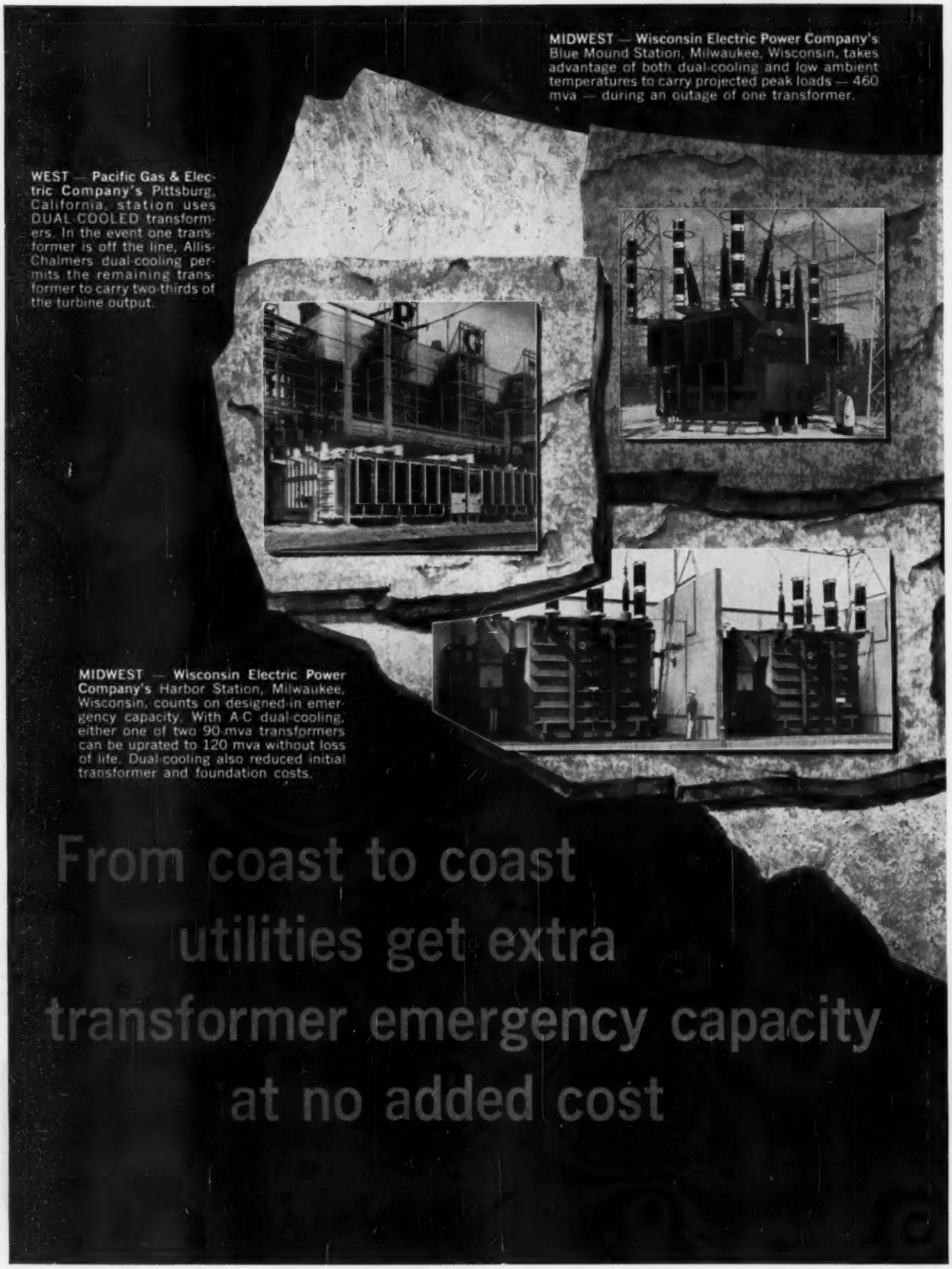
K/W GRIZZLY POWER CABLE SPEC. 831
VALUE 270% RATING

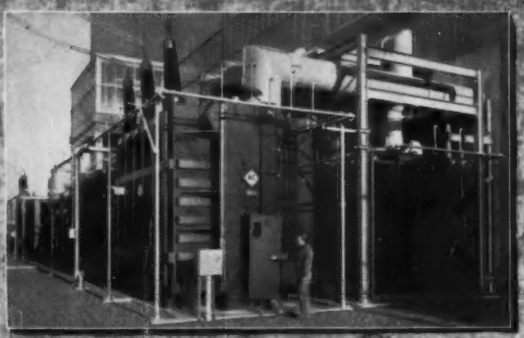
KAISER LAYTEX® CONTROL CABLE SENDS "THOR" TOWARD ITS TARGET

A single K/W Laytex control cable of 84 conductors gives Air Force "Thor" its final sendoff. Kaiser Wire has designed more than 650 such cables for missile ground controls, offering distinct advantages: Patented K/W Laytex gives greater insulation protection than any other rubber, and resists heat better than plastics. The patented Laytex-Resin construction delivers final cable diameters that are among the world's smallest. The choice of K/W insulations is the industry's widest.

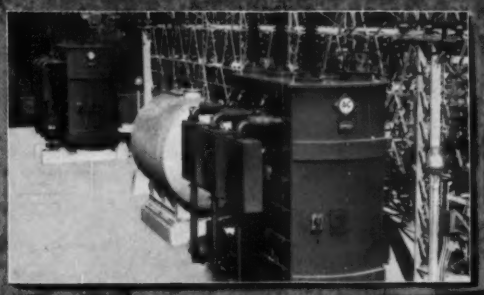
K/W LAYTEX-RESIN CONTROL CABLE
VALUE 767% RATING

IN COPPER AND ALUMINUM CABLES... THE SPARK OF QUALITY IS KAISER WIRE EXPERIENCE! KAISER ALUMINUM


MIDWEST — Wisconsin Electric Power Company's Blue Mound Station, Milwaukee, Wisconsin, takes advantage of both dual-cooling and low ambient temperatures to carry projected peak loads — 460 mva — during an outage of one transformer.
WEST — Pacific Gas & Electric Company's Pittsburg, California, station uses DUAL-COOLED transformers. In the event one transformer is off the line, Allis-Chalmers dual-cooling permits the remaining transformer to carry two-thirds of the turbine output.
MIDWEST — Wisconsin Electric Power Company's Harbor Station, Milwaukee, Wisconsin, counts on designed-in emergency capacity. With A-C dual-cooling, either one of two 90-mva transformers can be uprated to 120 mva without loss of life. Dual-cooling also reduced initial transformer and foundation costs.
From coast to coast utilities get extra transformer emergency capacity at no added cost



EAST — Philadelphia Electric Company's Eddystone Station has twin A-C 200-mva DUAL-COOLED transformers that jointly carry the output of one generator. With inter-connected manifold-cooling, one transformer can carry practically the entire load of the generator if the second transformer is out of service.



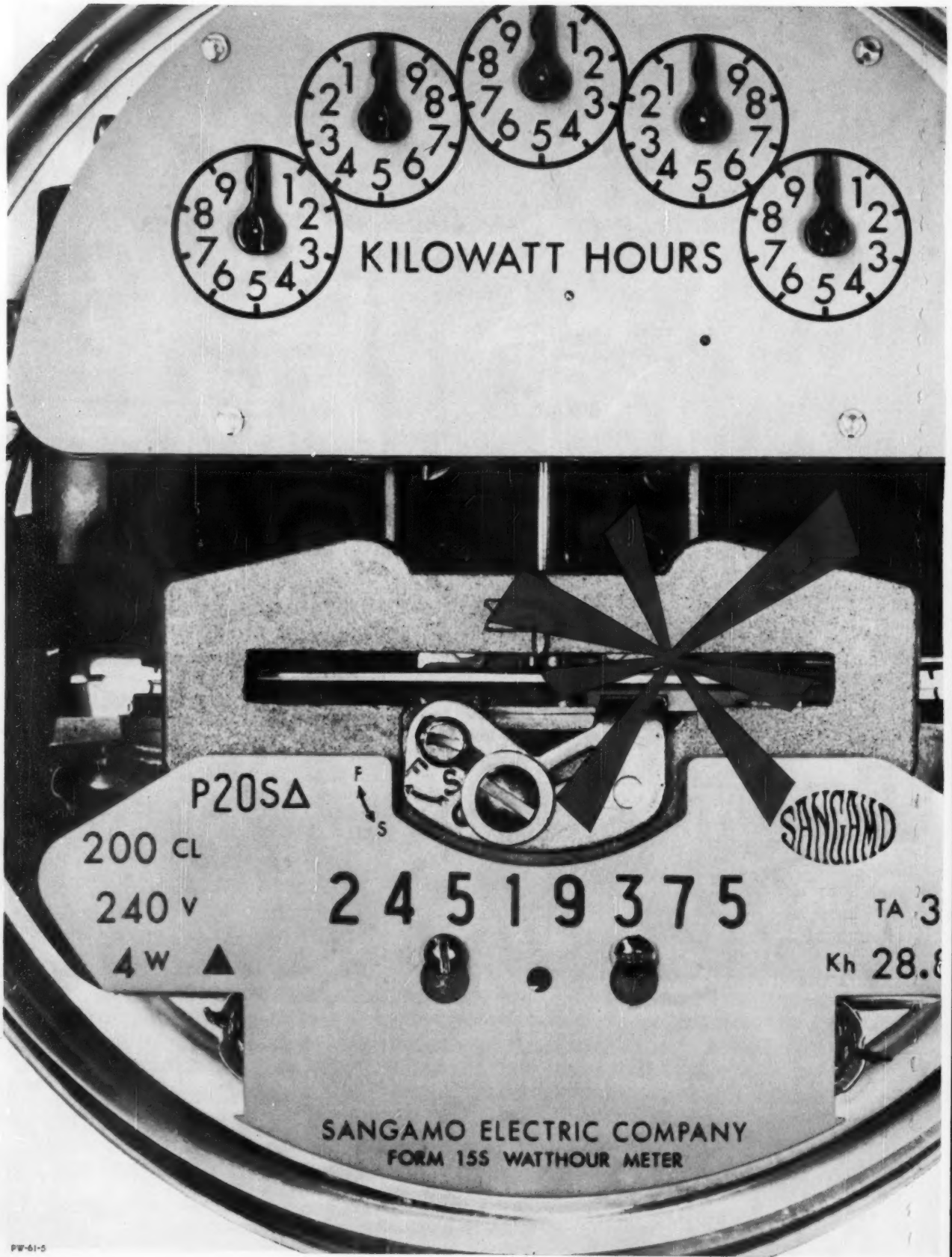
SOUTH — Gulf Power Company's Bayou Chico Substation, Pensacola, Florida. Previously applied on only larger transformers, A-C dual-cooling offers economies for smaller units too. Here, either of two 20,000-kva DUAL-COOLED transformers can be uprated to 26,667 kva.

DUAL-COOLED transformers boost emergency capacity without loss of life! Throughout the nation more and more utilities are turning to DUAL-COOLED transformers as an economical new way to get central station and substation emergency capacity. DUAL-COOLED transformers—an Allis-Chalmers development—utilize a bank of two or more transformers. During an emergency, while one transformer is off the line, its cooling equipment is connected to the functioning transformers. Result: Capacity of any DUAL-COOLED transformer can be increased over its normal rating. *Dual-Cooled transformers is an Allis-Chalmers trademark* A-1468

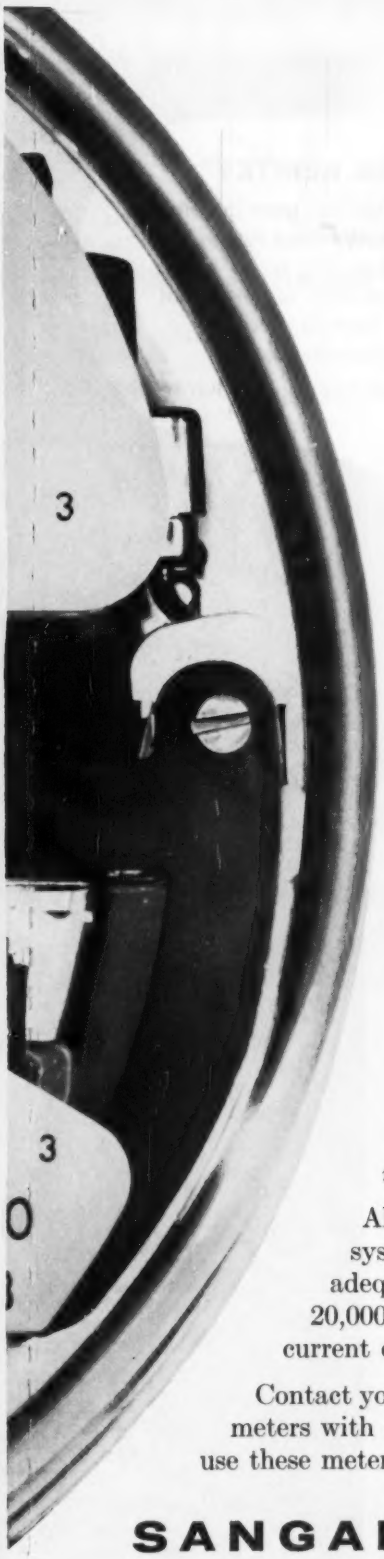
FOR DETAILS CALL YOUR NEARBY A-C OFFICE OR WRITE

ALLIS-CHALMERS

POWER EQUIPMENT DIVISION, MILWAUKEE 1, WISCONSIN


KILOWATT HOURS
P20SΔ
200 CL
240 V
4W ▲
SANGAMO
24519375
TA 3
Kh 28.8
SANGAMO ELECTRIC COMPANY
FORM 15S WATTHOUR METER

PW-61-S



the maker's Sangamo... the meter's polyphase... *and the disk floats...*

to provide the highly sustained accuracy needed to better measure today's large loads. The moving system of these 2 and 3 stator polyphase meters floats freely and permanently on a magnetic field created by opposing magnets. It's not supported or suspended by friction-causing components. *This is true magnetic flotation,* made extremely stable by specially bonded Alnico magnets that are dimensionally and magnetically uniform. It's available now on the complete line of Sangamo P20 (two stator) and P30 (three stator) polyphase meters.

P20 and P30 meters, with true magnetic flotation, retain all the advantages traditionally associated with Sangamo polyphase meters such as slow speed, high torque, high insulation level, low losses, and low starting watts. Construction is still sectionalized and parts are interchangeable . . . only the frame has been changed to accommodate the floating system.

The compact outline of Sangamo polyphase meters hasn't been changed. The P30, for example, is the *lightest, smallest, three-stator meter made . . . the only one with single disk, round cover design.*

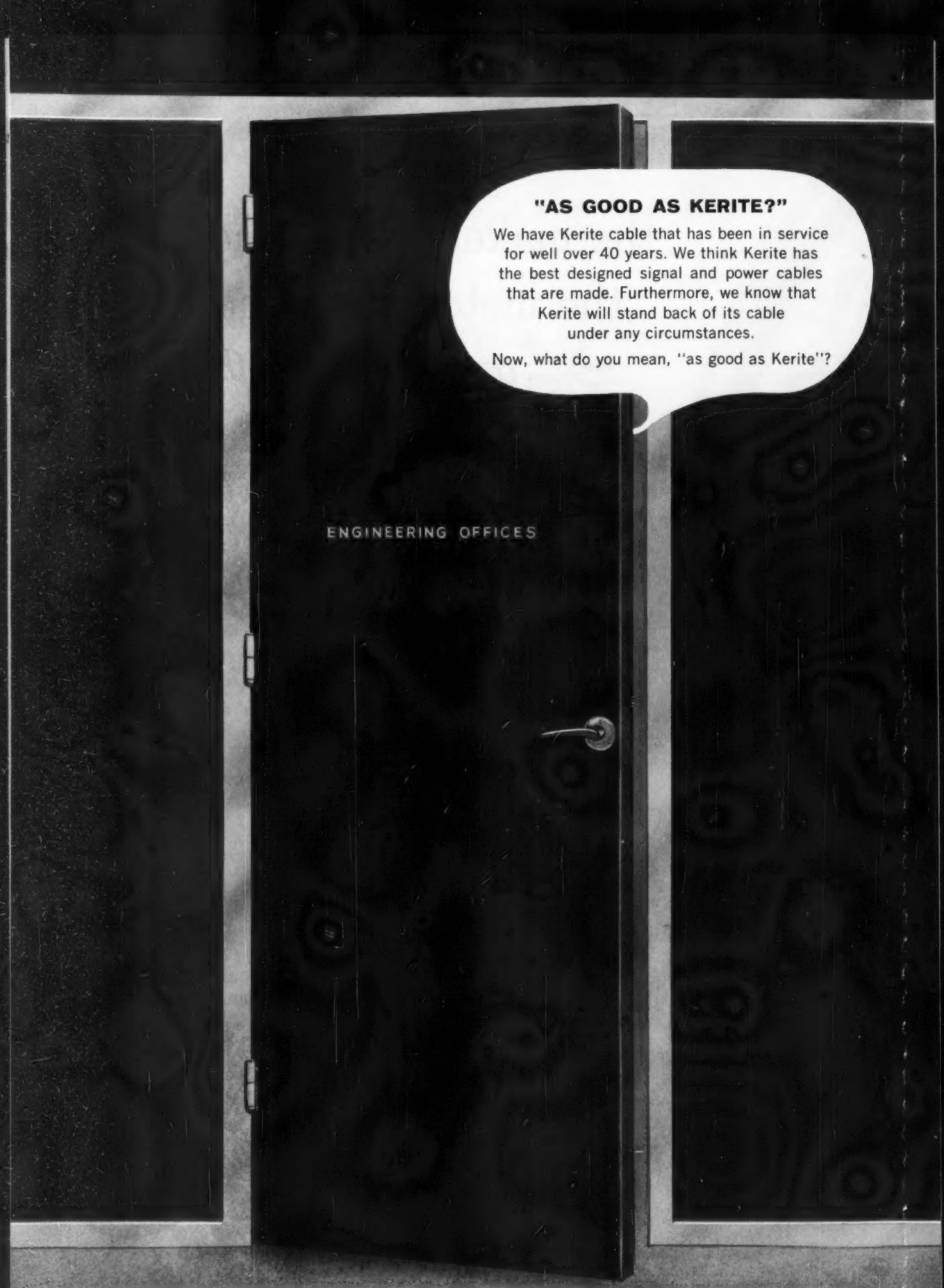
All components of the P20 and P30 meters, including Alnico floating system magnets, damping magnets and electromagnets, have more than adequate surge resistance. The meters easily pass high current tests of 20,000 amperes through the neutral wire and 2,000 amperes through the current coil.

Contact your Sangamo Representative and get the full story on these exceptional meters with the moving system that is guaranteed for the life of the meter. Then use these meters to insure full revenue from large loads.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

SANGAMO


"AS GOOD AS KERITE?"
We have Kerite cable that has been in service for well over 40 years. We think Kerite has the best designed signal and power cables that are made. Furthermore, we know that Kerite will stand back of its cable under any circumstances.
Now, what do you mean, "as good as Kerite"?
ENGINEERING OFFICES

THE KERITE CO., 30 CHURCH ST., NEW YORK 7, N. Y. DESIGNERS AND MANUFACTURERS OF PREMIUM GRADE INSULATED WIRE AND CABLE, SPLICING TAPE, RUBBER CEMENT. AGENTS IN PRINCIPAL CITIES. A MEMBER OF RAILWAY PROGRESS INSTITUTE.

Editorial Comment

JULY 24, 1961

Utter Confusion on Upper Colorado Transmission Lines

Consider now the plight of the members of the Public Works Subcommittee of the House Appropriations Committee as they sit down this week to consider how they will handle an Administration request for $14.5 million to initiate construction of a transmission network for the Upper Colorado storage area which will eventually cost $176.2 million, or $182.9 million, or is it $187.7 million (page 26)?

At first it seemed simple. Both the Eisenhower and the Kennedy Administrations had backed the original all-federal transmission plan.

But the five investor-owned companies in the area said it was inadequate.

Bureau of Reclamation, which would have responsibility for the federal plan, listened and modified the plan. This increased the cost 4%—or was it 6%? The Bureau told the Subcommittee in closed session, but evidently did not tell opponents or proponents of the modification.

On June 11, the opponents and the proponents told the Subcommittee their views—but then they were talking about the original plan, not the new Bureau plan. The opponents did come in later with a two-page comment on the new plan. They thought it was worse than the first one.

As the Subcommittee sits down this week it has some 250 pages of testimony from outside witnesses on the Upper Colorado transmission plan, but only two pages relate directly to the new Bureau of Reclamation plan.

There is one more complication. The Bureau of Reclamation has indicated it may want to make further changes.

PG&E Moves Again on Nuclear Energy

Pacific Gas & Electric Co has announced (EW, July 10, p 54) intent to energize, in 1965—and entirely with private financing—a 325-Mw nuclear power plant. This again presents proof that economically competitive atomic power is ready, at least in some fuel-cost areas and under some system and financial conditions.

This utility's nuclear background is extensive and impressive. Thus, its first-core estimate of 5.62 mills per kwhr at the bus of this BWR plant is the more startling. Witness: The AEC in 1959 programmed this reactor size and type to arrive at a 7.45-mill ability by 1967. The manufacturer (p 28) recently estimated that essentially this plant would do 6.78, using AEC's assumptions. This not only reflects the recent fuel price cut, but indicates design progress beyond AEC hopes.

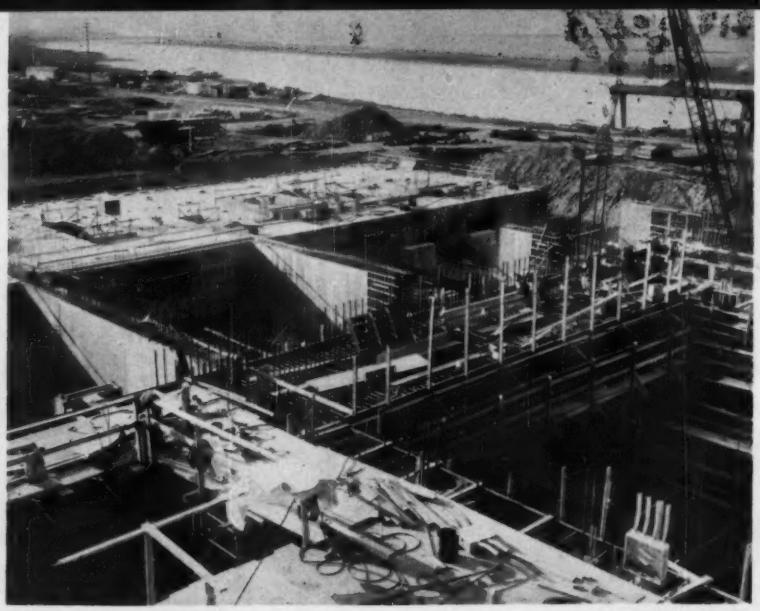
PG&E's calculations showed nuclear would beat available fossil fuel at the selected time and place by 0.15-1.20 mills, and this valid comparison cinched the case for its decision. But it elected not to give the full assumptions under which it determined the 5.62 figure.

There's real risk here. The uninitiated, the devious, may use the unsupported estimate for improper comparisons—especially with fossil fuels under other system and financial conditions. Inferences may be drawn that nuclear power has wider economic application today than is the case. Until PG&E feels it can give full data, this danger will have to be lived with.

Meanwhile, it is nonetheless clear that nuclear power is advancing somewhat faster than many had hoped for, a few short years ago.

It is likewise evident that investor-owned utilities, led by progressive companies like PG&E—far from "dragging their feet" as alleged—are pursuing competitive atomic energy aggressively.

Senate Votes to Reinstate Hanford Generators



PLUTONIUM PRODUCTION facilities at Hanford are already under construction

Fate of the proposal to install some 760-Mw of electrical generating capacity at the Hanford (Wash.) New Production Reactor (NPR) is up to the House again this week. Outcome will depend on how strongly that body feels on knocking the $95-million proposal from the Atomic Energy Construction Bill.

The Senate voted last week 54 to 36 to reinstate the NPR power facilities in the bill. The House had voted the previous week 176 to 142 to delete the NPR provision from the bill.

In a little noticed move during the debate, the Senate also adopted an amendment which would authorize a $5-million research program for studying the possibilities of using atomic energy to gassify coal. This nod to the coal industry could be interpreted as an attempt to break up the coalition of southerners, Republicans, and coal-state legislators that defeated the NPR proposal in the House.

The House and Senate versions of the bill was referred to a conference committee made up of members from the Joint Atomic Energy Committee. There was no doubt that this conference group would report out the bill with NPR restored and very likely including the coal research amendment.

It would then be up to the two Houses of Congress either to accept the bill reported out by the conference committee, or to reject it—thus sending it back to the conference committee again.

Rep Craig Hosmer (R-Calif.), one of the House leaders in opposition to the NPR power facilities, told *Electrical World* that a vigorous effort would be made to keep the NPR provision out of the final bill. He said he had conferred with Rep James E. Van Zandt (R-Pa.) and others who opposed the NPR power facilities. It has been decided to ask for a roll-call vote on the conference report when it comes out, Hosmer said. If the House sustains its previous vote on the NPR facilities, it could then instruct its members of the conference committee to meet again with the Senate members and insist on deleting NPR from the bill.

However, the rejection of a conference report by either House is unusual, and House opponents of the NPR provision realize their task is more difficult than during the first House vote on the provision. This is further complicated by the Senate amendment on coal gassification research which could change the previous votes of coal-state Congressman.

The restrained Senate debate centered entirely on the NPR provision. Sen Bourke Hickenlooper (R-Iowa), leading the opposition, argued that the proposed generating facilities would be inefficient and the power would be much more costly than if produced by a conventional plant.

But Joint Atomic Energy Committee Vice Chairman John Pastore (D-R. I.) said that there would be a severe waste of resources if the NPR facilities were not built. He declared, "It will benefit an important section of our country and that, in turn, benefits the entire country."

The House vote was somewhat of a surprise to the Kennedy Administration and to Congressional supporters of the NPR power facilities. It had come on an amendment by Rep Van Zandt and followed sharp exchange of views on federal power.

Republican arguments centered on the economic unsoundness and the "dangerous precedent" of setting up AEC as a government power agency alongside the Interior Department, TVA and the Army Engineers.

Rep Craig Hosmer (R-Calif.) delivered the telling blows when he offered refutations of the Democrats' arguments on economic advantages, national prestige and defense.

A future drive for a federal power reactor construction program also hinges on the final outcome of the generators. Rep Chet Holifield (D-Calif.), chairman of the Joint Committee who led the fight for hooking up the power facilities to NPR in the House, said earlier that he would not press the campaign for a government-financed atomic power program if the NPR power facilities made it through Congress this year.

Water Resources Bill Introduced

President and Kerr Committee are in agreement on new legislation, and earlier conflict seems to be tabled

A national water resources council, various river basin commissions, federal grants to states for water resource planning—all would be authorized in new legislation recommended to Congress by President Kennedy.

Sen Clinton Anderson (D-N. M.) has introduced the President's proposal in a new bill (S-2246) which has been referred to the Senate Interior Committee. This bill replaces an earlier measure (S-1629) which included authorization only for the federal grants to states.

Hearings by the Interior Committee will be held shortly—probably on July 26 or 27.

Kerr Committee Views Adopted

This new Administration program is in line with recommendations of the recent special Senate committee on water resources, headed by Sen Robert S. Kerr (D-Okla.) (EW, Feb. 6, p 39).

The proposed water resources council is not to be confused with efforts to create a White House Natural Resources Council. Bills to that effect (S-239, S-1415) were considered earlier this year by the Senate Interior Committee, but the White House hasn't announced any plans for setting up such a body. The Natural Resources Council has been the subject of a bitter behind-the-scenes battle between liberals and moderates in the Kennedy Administration—the argument turning on whether a separate body should be created to study resources, or whether the Budget Bureau should have greater authority on resources planning.

Here are highlights of the Kennedy water resources proposal:

• A water resources council would be set up, composed of the secretaries of Interior, Agriculture, Army and H-E-W, with a chairman named by the President from among these *ex officio* members. Permanent personnel and a $19,500-yearly staff director also would be provided. The council would: **(1)** maintain a "continuing study" of water supply needs in each region of the country; **(2)** establish principles and procedures for preparing comprehensive regional and river basin plans, and for developing federal water resource projects; **(3)** approve or revise plans submitted to it by the various river basin commissions.

The Water Resources Council would be assigned the task of revising the present feasibility standards (A-47) for federal multipurpose projects, President Kennedy said in his message to Congress. The President emphasized that "the first major task of the Water Resources Council will be to establish, subject to my approval, standards for formulating and evaluating water resources projects. These standards will replace those (A-47) currently in effect . . ."

Most Washington observers feel this is certain to slow down any revision of the present standards—that it's not at all certain the water resources council will even be approved, at least immediately, by Congress. The Budget Bureau earlier had been directed to make such revisions. But the original deadline for revising the old standards has passed because of strongly differing views on how they should be changed. The decision that this new, yet-to-be-authorized agency would undertake the revision indicates that President Kennedy has wiped his hands of all previous plans, and will start fresh—maybe—at a later date.

• River basin water resources commissions would be set up by the President, upon the request of the governor of one or more of the states living wholly or partially within a water resource region, river basin, or group of basins "for which the commission is established and which (state) has a substantial interest in the planning and construction of water and related land resources developments therein." These commissions would be composed of one member of each interested federal agency, one or more members of each state affected by the water resource involved, plus possible added members from any interstate compact commission or international commission. The President would name a chairman who would not hold other employment during his tenure.

These commissions would: **(1)** serve as the "principal agency for the coordination of federal, state and local plans for the development of water and related land resources in its region," **(2)** prepare and submit to the council comprehensive and long-range plans for water development, **(3)** initiate studies in its area, **(4)** make an annual report to the council.

The President could terminate a river basin commission at any time.

• A total of $5 million yearly for ten years would be made available by the federal government as grants to states to conduct their own smaller-scale water planning. This money would be distributed by the Secretary of Interior on four criteria: population, area, financial need, planning need.

To date, 19 states have indicated their support for this federal grant program, while at least one state—Arizona—has opposed it. Arizona's objection is that federal funds would tend to force states to conform to federal policies on local water planning.

FPC Proposes New Rule On Headwater Benefits

Non-federal hydroelectric power operators could determine their own "headwater" benefits—between upstream and downstream reservoirs on the same river—under a new rule proposed by the Federal Power Commission.

The new rule would permit self-determination of such benefits without the expense of an FPC study, which must be charged to the involved operators. FPC final approval still would be required, however.

The Commission's proposal would revise its present regulations under the Federal Power Act, and interested parties have until August 14 to file their comments with the FPC.

Upper Colorado Lines Test Coming

Bitterly contested plans for an extensive transmission network in the Upper Colorado storage area face their first Congressional test this week.

The House Appropriations Subcommittee on Public Works, in considering whether to approve an Administration request for $14.5 million to initiate an all-federal transmission plan, apparently will have at least three alternatives:

(1) It can deny the request entirely and direct the Bureau of Reclamation to work out a cooperative plan with the five area investor-owned utilities, which have offered a firm proposal.

(2) It can recommend that the request be granted and thus give an initial go-ahead on an all-federal system.

(3) It can honor the request but direct that the money be used by the Bureau of Reclamation only to build lines that would be needed in connection with the investor-owned proposal for a combination federal-investor network.

Recently released testimony taken by the House Subcommittee in closed session during June indicates the interest and the bitterness which centers on the federal transmission plan. More than a score of witnesses, including two governors, a water users association, and top executives from the investor companies testified on behalf of the investor-utility plan.

Allied on the side of the all-federal plan were the Interior Department and its Bureau of Reclamation which would build the federal lines, along with some 80 witnesses representing rural electric cooperatives and municipalities in the Upper Colorado storage area (see box at left).

Most surprising disclosure to come from the published hearings is that the all-federal plan is still subject to modification. The bulk of the testimony taken from the non-government witnesses, it turned out, had been based on an all-federal plan which had been considerably modified, apparently without their knowledge.

The modifications, which consisted of raising voltages and changing ties in the previous federal plan, would increase the cost of the plan from $176.2 million to $182.9 million, according to Bureau of Reclamation estimates. A statement submitted by the investor companies indicated that the modifications would raise the initial investment in an all-federal system to $187.7 million. The investor utilities said the difference in estimates was caused by the need for larger switching facilities at Glen Canyon to accommodate the 345-kv circuits specified in the modifications.

In commenting on this latest modification proposed by the Reclamation Bureau for the all-federal system, the investor-owned utilities said: It "will not operate independ-

Arguments on Upper Colorado Lines

Following are some of the opposing contentions gleaned from nearly 250 pages of testimony taken by the House Appropriations Subcommittee on Public Works during the hearings on a proposed transmission network for the Upper Colorado storage area:

All-Federal Proponents	Investor Utility Advocates
The investor-utility plan would impose a virtual toll-gate on the power produced from federal projects.	The wheeling agreements proposed by the investor utilities do not mean control of generation facilities. Existing contracts of this type have proven of mutual benefit to investor utilities and the federal government.
Investor utilities are trying to delay construction of the transmission system. They have had ample opportunity to present their views to the Bureau of Reclamation.	The federal plan, even at this late date is not supported by adequate engineering data. The Bureau has not provided an opportunity to discuss opposing plans nor did it even make known its most recent modifications.
The investor utilities would pay no more than $406,744 per year in federal taxes as a result of the wheeling contracts.	Investor wheeling charges would be less than charges resulting from an all-federal system over the life of the project and return more than $100 million in federal taxes.
The investor-utility plan would cost $2.9 million per year more than the original plan submitted by the Bureau of Reclamation.	The investor plan would produce almost $1 million more in revenue for the government each year through elimination of heavy line losses on the Bureau's proposed federal system.
The investor-owned utilities would be given advantages worth several million dollars a year.	Investor utilities would pay more than $1.1 million per year as a result of the proposed wheeling contracts.
Investor utility proposals do not cover wheeling of preference customer generation necessary to achieve full diversity benefits.	The investor proposal would assure preference or project customers of better electric service through use of a multipurpose transmission system connected to many generating sources, all planned to do a total job.

ent of support from other systems, does not meet minimum utility standards, and is not improved over the May 1960 original yardstick system.

The system cannot deliver firm power to project customers unless support is received from the reserve power and transmission line resources of the investor-owned utilities through extensive interconnections; or, the reserve power from other federal and public systems increases greatly in the future and is dedicated to this use. In either case substantial expenditures will be necessary to provide reserve generating and transmission capacity for delivery of this power from the project. No funds are included in Bureau estimates for this purpose."

Witnesses Ignore Modifications

Not a single one of the 80 nonfederal witnesses advocating the construction of the all-federal transmission system referred to or commented on the modifications made by the Bureau of Reclamation. Their testimony indicated that they were testifying in behalf of the original Bureau plan.

The earlier Bureau proposal had received the endorsement of the Eisenhower Administration before it departed Washington earlier this year.

But there would seem to be some doubt whether the former Republican Administration endorsement would hold for the present Bureau plan which would raise the estimated federal construction costs by 4 or 6%.

Nor is there any guarantee that the Bureau will not come up with further modifications before finally settling on a plan. Rep Ivor D. Fenton (R-Pa.) told witnesses for the investor companies during the closed hearings that Bureau spokesmen had indicated they had not yet made final plans in some instances but were considering alternate lines.

Subcommittee Chairman Clarence Cannon (D-Mo.), who also heads the full House Appropriations Committee, indicated during the hearings that he is inclined to favor the all-federal plan. Comments by Rep Ben F. Jensen (R-Iowa), the ranking minority member, indicated that he leaned toward the investor-utility proposals.

Get Going on Public Power, NRECA Tells Administration

Directors of the National Rural Electric Cooperative Assn, at a semi-annual meeting in Washington, D. C., gave notice that they want the Kennedy Administration to get going on the resource and power programs it has promised in recent months and during the campaign.

The resolution was couched in carefully-chosen words, laying heavy blame on "commercial power companies and their allies" for slowing the resource progress and threatening to "destroy the Administration's announced programs."

The implication of the resolution, however, was clear: NRECA wants the Kennedy Administration to push forward with more of the promises on public power that were made in last fall's presidential campaign. Liberal Democrats on the Senate Interior Committee already have criticized the Administration's reluctance to endorse an independent resource advisory unit at the White House—Kennedy appears to prefer stronger resource planning within the Budget Bureau (EW, April 24, p 43; May 29, p 45).

The NRECA resolution stated that, "whereas the present Administration prior to taking office pledged dynamic programs in the field of resources and power . . ." and, "whereas dynamic and aggressive leadership by the President and the executive branch can overcome the present inertia created by the power companies . . ." therefore the White House should "give greater attention to the need for action in the resource development field . . . and take positive steps to place the program in reality . . ."

Kennedy's September, 1960, speech in Billings, Mont., before the Western States Power Conference, also was cited by NRECA.

The Billings speech had included the following points: **(1)** An "immediate" reversal of the "no new starts" policy, **(2)** Prevention of "another Hells Canyon blunder," **(3)** "Early authorization" of the Paradise - Knowles multi - purpose project, **(4)** "We will establish a council of resources and conservation advisors in the office of the President, to coordinate planning in the field," **(5)** Planning will be carried out, among other things to decide "how we might profitably link the power systems of the Columbia and Missouri rivers—and deciding where public and cooperative systems require steam as well as hydro plants," **(6)** "We will restore REA to its former role of pre-eminence."

Fryingpan Moves Toward House Debate

The Fryingpan-Arkansas Reclamation Project, Colo., is awaiting action by the House Rules Committee on when it can come up on the House floor for debate. The chances are good that it will be acted on in a few weeks (EW, June 26, p 14).

The long-proposed reclamation project, with 124 Mw, was recommended by the House Interior Committee, 19-4, in mid-June. A minority report of that Committee, opposing the project, has been signed by seven members, however.

Signers of the minority report are Republican Representatives John Saylor (Pa.), John Kyl (Iowa), Ernest Wharton (N.Y.), Odin Langen (Minn.), Craig Hosmer (Calif.); Democratic Representatives James Haley (Fla.) and D. S. Saund (Calif.).

According to the minority, "The Bureau of Reclamation's Project Planning Report (1950) designated the Fryingpan project as the 'initial development of the potential Gunnison-Arkansas project.' The Gunnison-Arkansas project would probably involve construction costs approaching $1 billion . . . would divert upward of 900,000 acre-ft of water annually from the Colorado River basin, or about ten times the amount of water proposed for diversion by the Fryingpan-Arkansas project."

Uranium Price Cut Affects Plants

Lower fuel costs will help advance nuclear development, but technological progress is a more important factor

Nuclear power plants in the 300-Mw class should generate electric energy for close to 6½ mills per kwhr, according to major manufacturers. Such plants would be those contracted for today and might be of several of the leading concepts.

The energy costs of the various concepts, given in the table, came down at the first of this month about 0.3 mills per kwhr as a result of the AEC's uranium price cuts (EW, June 12, p 44-45). But it is clear that advances by the manufacturers have been chiefly responsible for the low figures.

Pacific Gas & Electric Co, which recently announced the Bodega Bay boiling-water plant, has estimated 5.62 mills per kwhr energy cost from its first core there (EW, July 10, p 54). Because this figure is for the gross power of 325 Mw at the generator bus and at 90% plant factor, it cannot be compared directly with the figures in the table. The company did not give a breakdown of this energy cost.

The detailed figures from Atomics International and General Electric Co are all based on 80% plant factor and 14% fixed charge rate. The first's 300-Mw organic-moderated and cooled reactor would burn UO_2 enriched to 2.1% U^{235} and clad in APM aluminum. Operating at a surface temperature of 850F, this fuel would attain a burnup of 20,000 Mw-days per ton, produce steam at 1,000 psi and 700F, and yield a net plant heat rate of 9,950 Btu per kwhr. The installed capital cost is estimated at $185 per kw.

A 360-Mw advanced sodium-graphite reactor, also by Atomic International, would operate with UC fuel enriched to 3.5% and clad in stainless steel, whose surface temperature would be 1,200F. This plant would attain a burnup of 25,000 Mw-days per ton, generate steam at 2,400 psi, 1,050F/1,000F, and yield a net plant heat rate of 7,980 Btu per kwhr. Installed cost is estimated to be $200 per kw. The reduction in its uranium recovery cost in the table reflects the lower cost of reprocessing losses resulting from lower uranium price.

The energy costs for both these plants are based on the new AEC suggested value of $9.50 per gram for recovered plutonium and on the unchanged $1.50 per gram AEC plutonium conversion charge and 2% conversion losses.

General Electric's fuel cycle costs include transportation of new fuel under fabrication and of spent fuel under recovery. Plutonium credit here is based on $12 per gram. The total fuel costs of 2.10 mills per kwhr does not include a capital charge for fuel. If half the fuel load is capitalized, fuel cost would increase about 0.2 mill. The company also pointed out that the capital cost of the plant was based on a reference site and average US labor rates. General Electric attributes the lowering of costs to such technical developments as internal steam separation, pressure suppression, and high-power-density cores.

Babcock & Wilcox Co's figures are for a large spectral shift control reactor, which is a pressurized-water type with mixed heavy and light waters as moderator-coolant. The company is currently conducting

	General Electric Co			Atomics International				Babcock & Wilcox Co	
	BWR			OMR		SGR		Large spectral shift control reactor	
	300 Mw	400 Mw	500 Mw	300 Mw		360 Mw			
Capital charges	3.95	3.65	3.52	3.7		4.0			
Working capital	–	–	–	0.2		0.1			
Fuel cycle	2.10	2.10	2.10	1.5	[1.7]	1.6	[1.9]	2.1-2.6	[2.5-3.1]
Fabrication	1.00	Same as 300 Mw unit		0.61		0.39			
Depletion	1.12			0.90	[1.21]	1.10	[1.40]		
Use charge	0.28			0.09	[0.11]	0.10	[0.11]		
Plutonium credit	(0.60)			(0.40)	[(0.53)]	(0.18)	[(0.23)]		
Recovery	0.30			0.28		0.21	[0.23]		
Operation & maintenance	0.73	0.61	0.54	1.0		0.4			
Insurance				0.1		0.1			
Total, mills per kwhr	6.78	6.36	6.16	6.5	[6.7]	6.2	[6.5]	5.5-7	[6-7.5]
Reduction in fuel cycle cost by U price drop		0.3–0.4		0.2		0.3		0.4-0.5	

COST BREAKDOWN in mills per kwhr shows also pre-July costs, where different, in brackets. This breakdown follows that in the AEC's 1960 publication, "Civilian Power Reactor Program, Part II" on economic potential (TID-8517) (summarized in "Electrical World's" 5th nuclear power report, May 16, 1960, p 64)

critical experiments of this concept under AEC contract.

Allis-Chalmers Manufacturing Co reported that the July 1 uranium price cut would result in a fuel-cycle savings of about 10% for a 60-Mw Pathfinder-type reactor and about 20% for a 300-Mw plant. "This will definitely stimulate utility interest in nuclear power. We are very interested in the proposed bill that would permit the outright purchase of fuel. We feel that this is another step toward placing nuclear plants on the same basis as conventional plants," the company said.

General Atomic Division of General Dynamics said that the AEC's uranium price change would reduce materially the previously announced figures of 1.2-1.7 mills per kwhr for a 300-Mw high-temperature gas-cooled unit. The company agreed that the effect of this decrease in base price is several times the effect of raising the inventory charge from 4% to 4.75%. General Atomic did not give a cost breakdown, but said, "It would seem more appropriate to give more accurate figures after Peach Bottom has operated."

Clapp Speaks Against 'Territorial Encroachment'

Rural Electrification Administrator Norman Clapp has re-emphasized his stand on co-op G&T facilities. "Generation and transmission authority of REA is the very heart of the Rural Electrification Act," he told a co-op group at Spencer, Iowa, at dedication ceremonies of Corn Belt Power Co-op's 33-Mw Earl Wisdom steam station. (Corn Belt's generating capacity is now over 100 Mw.)

Clapp also cited the threat of territorial encroachment by power companies who hold franchises in expanding cities. He said this was a bigger threat than that of municipally-owned systems, and added, "We are convinced that the only practical answer to this threat lies in protective legislation on the state level . . . I have offered to come to any state where all the borrowers will agree to meet together to consider the need of territorial protection. I will assist in any way I can to help map out a unified campaign to solve the problem."

FPC Member Takes Own Life

The death of Federal Power Commissioner Frederick Stueck gives President Kennedy the problem of finding two minority party appointees to fill out the Commission. It also forces him either to persuade one of the departing Republican Commissioners to remain, or have a completely inexperienced panel of five newly-named Commissioners.

Arthur Kline, whose term expired in June, is a possible candidate for the remaining three years of Stueck's term. Another possibility is that Jerome Kuykendall might be persuaded to stay on.

Stueck was found in his garage, apparently a suicide, police said.

STUECK

Iowa Co-op Joins Power Pool

Corn Belt Power Cooperative, an organization of 13 distribution co-ops in north central Iowa, is preparing to join the Iowa Power Pool. The power pool is presently made up of five investor-owned utilities.

Corn Belt, with 108-Mw of generating capacity, was invited to join the power pool and at last reports from its manager, H. W. Hope, ". . . papers are now being signed."

Present pool members are Iowa-Illinois Gas & Electric Co, Iowa Electric Light & Power Co, Iowa Power & Light Co, Iowa Southern Utilities and Iowa Public Service.

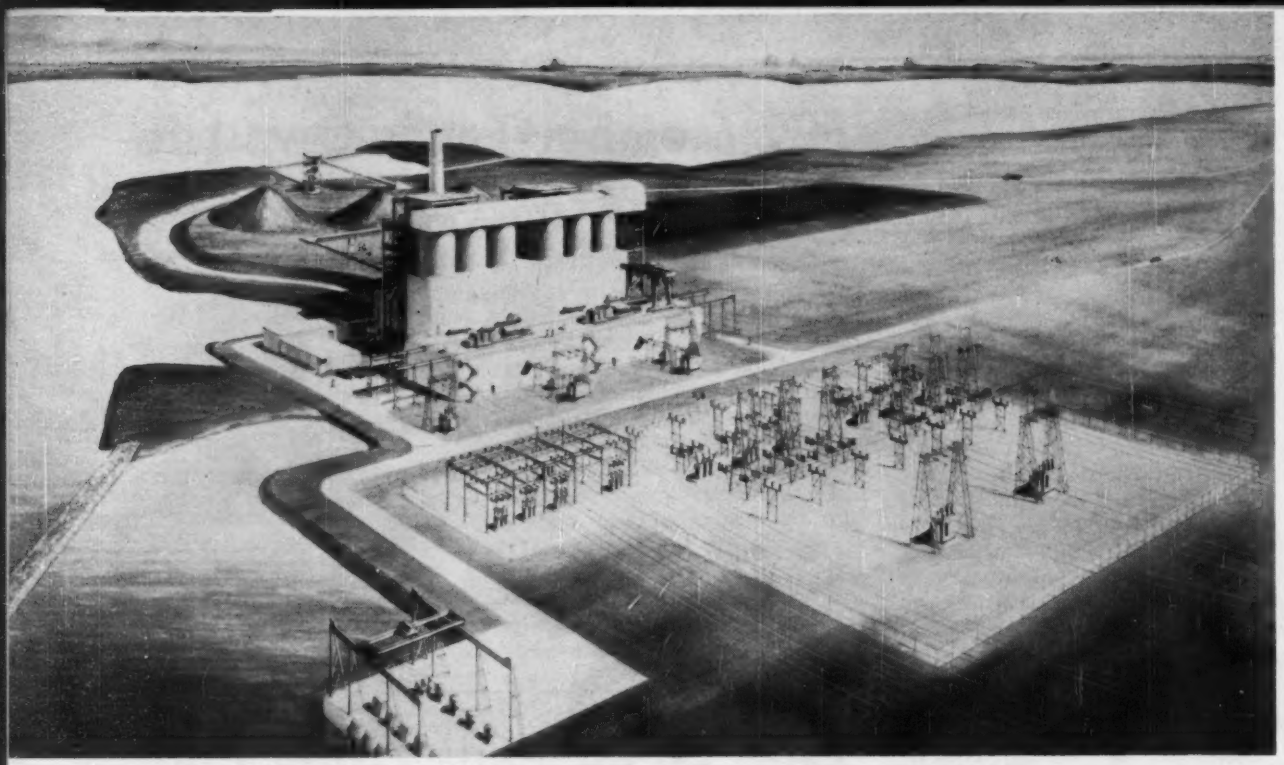
The area served by the 13 members of Corn Belt covers most of 28 counties in the north central part of the state. Latest addition to the co-op generating facilities was the Earl F. Wisdom plant, a 33-Mw unit located near Spencer, which was introduced with an open house just two weeks ago. Plans exist to add another 66 or 100-Mw in the next few years. (See story at left)

Hope said the co-op plans to build a 161-kv line from the new plant east to Mason City. Corn Belt will also be connected with a Bureau of Reclamation 161-kv line now under construction from Sioux City to Spencer. It is supposed to be completed by next July 1. Hope said Corn Belt is already tied to the power pool at several points, mostly with 69-kv lines, but with one 115-kv line.

Corn Belt will become member following approval of REA. This approval is expected later this year, according to Hope.

Commenting on a basic policy decision (EW, Apr. 17, p 14) that Iowa Power Pool will be considered as a single system for generation and transmission planning, Hope told *Electrical World* he sees this decision as no objection to Corn Belt being a member of the pool. When the time comes to add new capacity, Corn Belt can sit down with other pool members to determine who will build the capacity and associated transmission lines. It is also felt that the new policy decision will not disturb one of the principles under which the Iowa Power Pool has been operating since its formation in 1952, i.e. "Each company must own or have under control sufficient generating capacity for its own needs; likewise, sufficient transmission capacity for power delivery to its customers."

Being a pool member will still allow Corn Belt, as well as the five investor-owned pool members, to obtain power in the future from non-pool members. At present the Iowa Power Pool is interconnected with utilities in Illinois, Missouri, Nebraska, S. Dakota and Minnesota.



Four Corners Steam Plant Rises:

Arizona PS uses Navajo Reservation site near coal field; builds 110-ft dam; Phoenix to get power over 300 miles

T. A. PHILLIPS, Vice President, Arizona Public Service Co, Phoenix, Ariz.

A coal-fired steam electric generating station to be known as Four Corners Power Plant is under construction on the desert southeast of the intersection of Arizona, Colorado, Utah and New Mexico borders. Power from it will be transmitted about 300 miles over 345-kv transmission lines to the rapidly growing Phoenix area.

Both the plant site and the coal field supplying fuel are on the Navajo Indian Reservation six miles southwest of Fruitland, N.M. The Navajo Tribe has leased the site to Arizona Public Service and the coal fields to Utah Construction & Mining Co. The US Interior Department approved both agreements late last year.

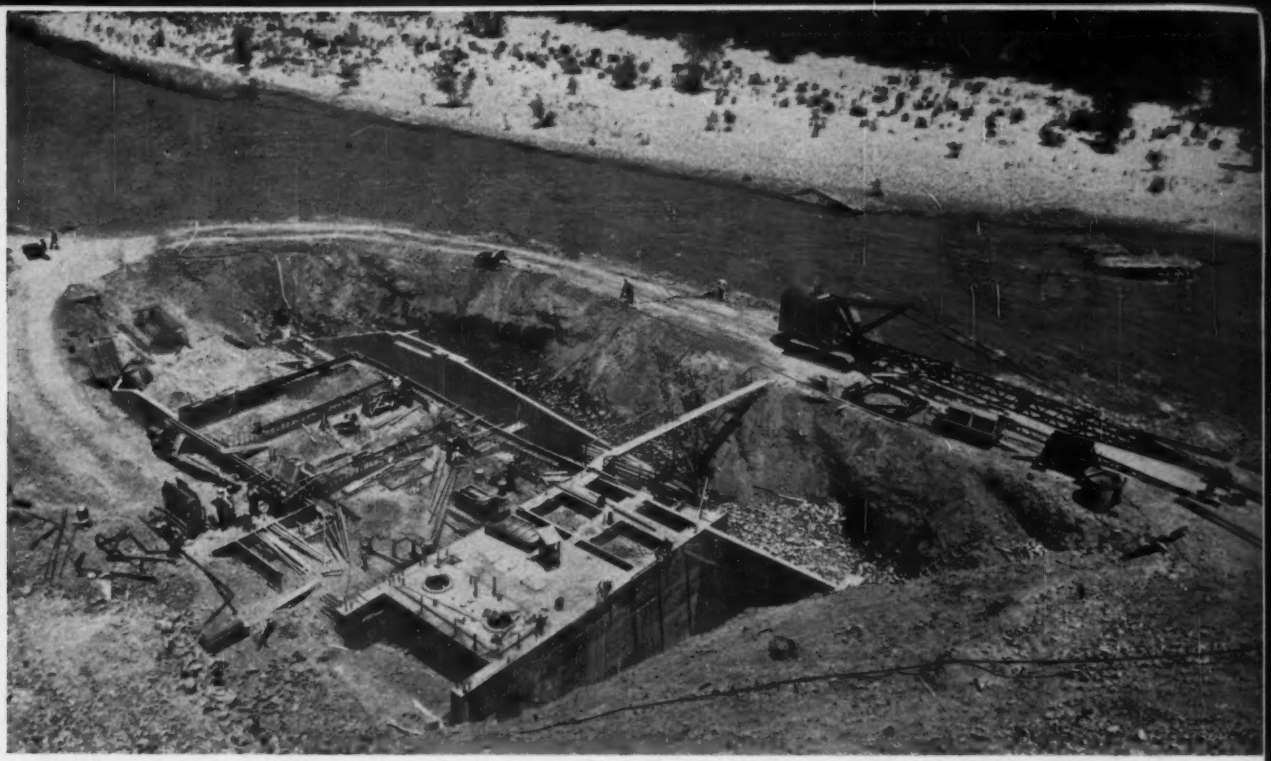
The site is so barren that the first airplane sent to photograph it missed it completely. But future travelers in this land of legend will soon see a 20th-century structure at the end of a 6,800-ft-long, 110-ft-high earth-filled dam. On one side of the plant will be a 1,200-acre lake, holding 39,000 acre-ft of water; on the other side, a 400,000-ton pile of coal.

The new plant, big by APS standards, will have an initial capacity of 350 Mw in 1963 and an ultimate capacity of 1,250 Mw, the limit set by water supply. Two 175-Mw units will be ready for operation in the spring of 1963, and plans call for two 225-Mw units in the mid-1960's.

Complete outdoor construction for all units will reduce initial costs and coal dust problems. The only enclosed areas will be the auxiliary bays under the turbine pedestals. Each reheat boiler will have three silos and ball mills to supply the coal to produce 1,270,000 lb per hr of steam. The turbines will be 175-Mw tandem compound double-flow machines with steam conditions of 1,800 psi and 1,000/1,000F. The generators' liquid-cooled stators will be rated at 175-Mw output, or 192 Mva at 90% pf with a short-circuit ratio of 0.64. Other plant equipment will be conventional. There will be no cooling towers.

Provisions are included for full automation of controls and equipment, but full automation is projected for a later date due to difficulties in the automation of a coal-fired plant and excessive costs of such equipment. A monitoring and remote computation system, however, is included. It will permit a minimum operating personnel and improve data and results computations.

Coal from this field is of sub-bituminous quality with a heat-content range from 8,000 to 11,000 Btu per lb. The extent of the field has not been determined but exploratory drilling proved there is enough coal to supply a plant of this size for many years beyond its expected life. Known deposits lie in a north-south strip, from half to three miles wide and 25 miles long. The first usable seam lies under a 30-ft over-



To Transmit Over 345-Kv Lines

burden, which gradually increases to the east to a depth of 120 ft. Strip mining will be used by Utah Construction to remove the overburden and mine the coal.

The coal for plant use from the ready pile will have a minimum heat content of 8,500 Btu per lb, obtainable by blending higher with lower-heat content coal. Several methods of obtaining a continuous measurement of the varying Btu content have been investigated, but none has proved satisfactory. It is hoped that a system for accurately measuring a continuous sample for Btu content, percent water, ash, and sulphur will be in operation by the time the plant is ready, as the Btu content will determine the price paid for the coal.

An ample supply of water is available from the San Juan River, although seasonal flow variations will require a storage reservoir to maintain sufficient water during low-flow, summer months. An earth-filled dam 6,800 ft long and 110 ft high will hold 39,000 acre-ft in a natural basin next to the plant site. Two river transfer pumps, each having a capacity of 15,000 gpm against a head of 475 ft and driven by 2,000-hp motors, will pump water 13,000 ft for the initial fill and reservoir makeup.

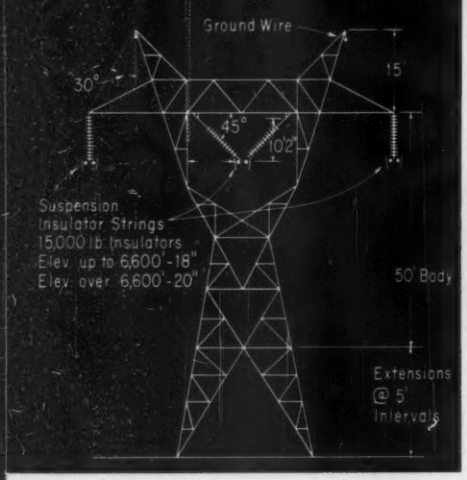
Annual water loss from the reservoir by evaporation, seepage, blow-down, and plant use, cooling and makeup is estimated to be about 33,200 acre-ft for the 1,250-Mw plant, but only about 15,000 acre-ft for the first two units. Initial filling will take 394 days of pumping. Power for pumping and construction is supplied from Farmington. Total dissolved solids in the river water have been measured at 350 to 50,000 ppm, the average around 10,000 ppm. After initial filling, selective pumping will obtain water of low ppm, thus reducing blowdown for maintaining the desired level of solids in pond water.

The original transmission system from Four Corners Plant will be two parallel, 345-kv tower lines of bundled conductor (795-MCM ACSR), 159 miles to the mid-point switching station at Cholla Power Plant near Holbrook, Ariz.

From Cholla to a switching station at Pinnacle Peak, ten miles north of Phoenix, there will be a single bundled conductor 345-kv tower line for 133 miles. The Pinnacle Peak terminal station will be tied into a 230-kv loop system encircling Phoenix.

Single-circuit, 345-kv transmission lines were chosen to insure maximum continuity and reliability, as the plant is very far from load centers and supplies a large percentage of the company's power requirements. Bundled conductors were selected as the most economical arrangement based on transmission-line investment, operating costs, and system reactive requirements.

These transmission lines will cross country with a multitude of soil, weather, and atmospheric conditions. Starting at the north end at about 5,000-ft elevation and going southward over a 9,200-ft timbered pass in the rugged Chuska Mountains, the lines pass Canyon de Chelly, cross the high plateau (5,000-7,000 ft), Navajo Indian Reservation, and touch the Painted Desert. They cross US Highway 66 near the relative lowlands (5,000



STANDARD TANGENT TOWER in 345-kv transmission line will transfer power from Four Corners to the Phoenix area

ft) of the Little Colorado River, proceed south to the unpredictable Mogollon Rim at 8,000 ft, and go down from the Rim to the Tonto Creek area skirting the Mazatzal Wilderness and passing on into upper Paradise Valley ten miles from the center of the Valley of the Sun. In this total distance of 290 miles, the lines have an altitude variation of 7,400 ft and an isokeraunic variation from 60 to 30.

The lines will contain about 1,600 towers, 3,600 miles of conductor for phase wires and overhead ground wires, and enough insulators, if connected in one string, to be ten miles long. Basic design parameters are: Average span: 1,260 ft; conductor: two, bundle 795-MCM, 26/7-strand ACSR (Drake) at 16 in. sub-conductor spacing; overhead ground wire: ⅜-in. HS steel strand (7 strand); sag: 27.9 ft at 60F to 31.3 ft at 120F with ground clearance 30.9 and 27.5 ft, respectively. Suspension insulators vary from 17 at 3,000 ft to 18 at 6,600 ft and 20 between 6,600 and 10,000 ft, with a 32-ft phase spacing.

Computers Used

In the design of the 345-kv transmission system, maximum use was made of digital computers and the network and transient analyzers. Computers ranged from Univac I and the IBM 704 to Univac Solid State 90.

Studies took into account not only steady-state conditions at light and maximum loads, but also steady-state and transient stability, and transient overvoltages for various modes of operation, such as line-out operations, reclosing after fault, line energizing and dropping.

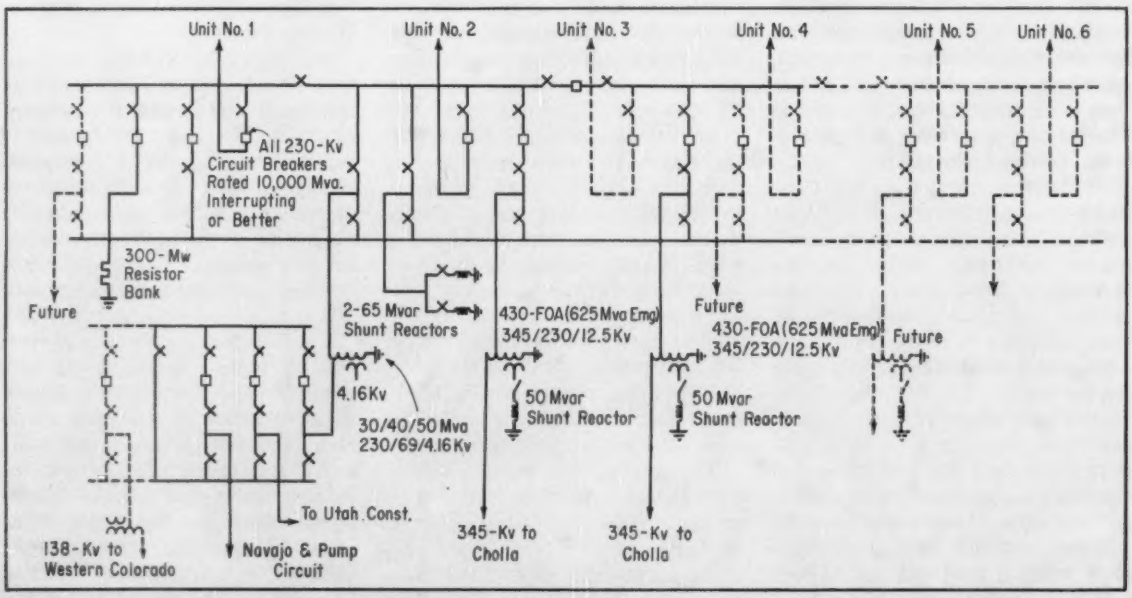
The 290 miles of line presented some unusual problems. Steady-state stability is a limiting factor on the amount of power that can be transferred, so that it is always necessary to operate the Four Corners machines in the area of lagging power factor. This condition necessitates the use of reactors on the bus to offset the charging capacity at the sending end of the 345-kv lines and provide enough reactive load for the generators. In addition, 40% series capacitance compensation for each 345-kv line will be needed to reduce the electrical length.

Reactors Split

Reactors at the buses will be split in two groups, one connected to the 230-kv bus, and the other to the low-voltage bus of the 230/345-kv autotransformers. This arrangement permits switching off of part of the reactors when line breakers take a line section out of service.

Reactors at Cholla Station will hold the tie to the 230-kv bus within acceptable limits. This reactance, together with the voltage control available from the Cholla machine, will provide adequate and flexible control of voltage at this "midpoint" station.

At Pinnacle Peak Switching Station, reactors will be in the transformer tertiary to maintain satisfactory control under normal operation, and capacitors will be needed under one-line-open conditions. No tap-changing-under-load equipment will be used, as satisfactory voltage levels can be maintained by reactors and



SWITCHYARD at Four Corners Station is shown in this preliminary one-line diagram. Existing and proposed transmission lines from the Four Corners Steam Plant are indicated along with the amounts of block power to be transmitted

capacitors with a minimum of switching, as the Four Corners Plant normally will run close to base load.

Transient stability presented unusual problems, due to the long electrical distance between the Four Corners and the Phoenix area. The more stubborn cases were controlled by dynamic braking (resistor insertion at time of fault removal) to absorb the energy going into accelerating power during the transient swings, the resistors remaining on for some 40 cycles to assure reclosure.

The major substation and switching stations associated with the transmission system are: (1) Four Corners Switchyard, adjacent to the station, northern terminal of the line; (2) Cholla Switchyard adjacent to the station and roughly at the midpoint of the 345 kv-line; and (3) Pinnacle Peak Substation at the southern 345-kv line terminus on the northeast side of Phoenix.

Switching at Terminals

All switching facilities at the terminals will be 230 kv, autotransformers stepping up to 345 kv being arranged on a unit system as part of the lines. This arrangement of low-side switching was decided upon for these reasons: Lower initial costs due primarily to the necessity of having reactors switched with the lines; other system ties anticipated at 230 kv; and, more experience at 230 kv with auxiliary equipment on the bus, such as high-voltage reactors and loading resistors.

Table I—Four Corners Station

Generators No. 1 & 2	
Output	175,000 Kw
Output	192,000 Kva
Power Factor	0.9
Voltage (3-Phase)	20 Kv
Speed	3600 Rpm
Exciter Rating	740 Kw @ 375 V
Short-Circuit Ratio	0.64
Hydrogen Pressure	30 Psig
Turbine	1,800 Psi/1,000F/1,000F
Boiler	1,270,000 lb/hr
Heaters	6
BF	2/50%/710,000 lb/hr
Condenser	2 Pass/100,000 sq. ft.
Coal (Proximate Analysis)	
Btu Range	8,500–11,000 Btu/lb
Ash	6–25%
Water	8–16%
Volitate	30–36%
Carbon	30–41%
Sulphur	0.48–1.90%

Reservoir	
Area	1,275 Acres
Capacity	39,000 Acre-ft.
Dam	
Length	6,800 ft.
Height	110 ft.
Step-Up Transformer	
2—200 Mva, FOA, 3-phase 230 Kv wye to 20 Kv delta, outdoor oil-filled	
Make-up System	
Pumps	2/15,000 Gpm
Type	Verticle Turbine
Motor	2,000-Hp Syn
Pipe Line Length	1,300 ft.
Station Auxiliaries Tsf.	
2—12,000 Kva OA/future FA, 3 phase, 19-Kv delta to 4,160-V delta, outdoor, oil-filled	

At Cholla, 345-kv circuit-breaker bays will be used with a transfer-trip arrangement, so that the breakers at both ends will trip simultaneously. A 345 to 230-kv autotransformer will tie the 345-kv transmission system to the Cholla Plant bus and the area's 230-kv transmission system.

All three stations will have the same basic design, utilizing a main and transfer bus arrangement. Transformers for local loads and 230-kv reactors normally will be energized from the transfer bus, but there will be provisions for switching them to

(*Continued on page* 60)

Table II—Four Corners 345-Kv Lines—Line Characteristics

1. Length, Four Corners–Cholla, Cholla–Phoenix: 159 miles, 133 miles

2. Elevation:

27 miles	1,750–3,300 ft.
183 miles	3,300–6,600 ft.
82 miles	6,600–9,200 ft.

3. Isokeraunic Level:

Phoenix	30 days
Cholla	50 days
Four Corners	55–60 days
Average	50 days

4. Average Span: 1,260 ft.

5. Conductor: 2/c bundle 795-MCM 26/7 strand ACSR @ 16-in. sub-cond. spacing
Overhead Ground Wire: ⅜-in. HS Steel Strand (7)

6. Sag

	Cond.	OGW
60F	27.9 ft.	22.9
120F	31.3 ft.	25.7

7. Ground Clearance

60F	30.9 ft.
120F	27.5 ft.

8. Suspension Insulators

Elevation	Insulators Per String	Rod Gap
0– 3,300 ft.	17	72.2 In.
3,300– 6,600 ft.	18	81.7 In.
6,600–10,000 ft.	20	85.2 In.

9. Tower Footing Resistance: 10 to 20 ohms

Provide Group Fusing for 100-Kvar

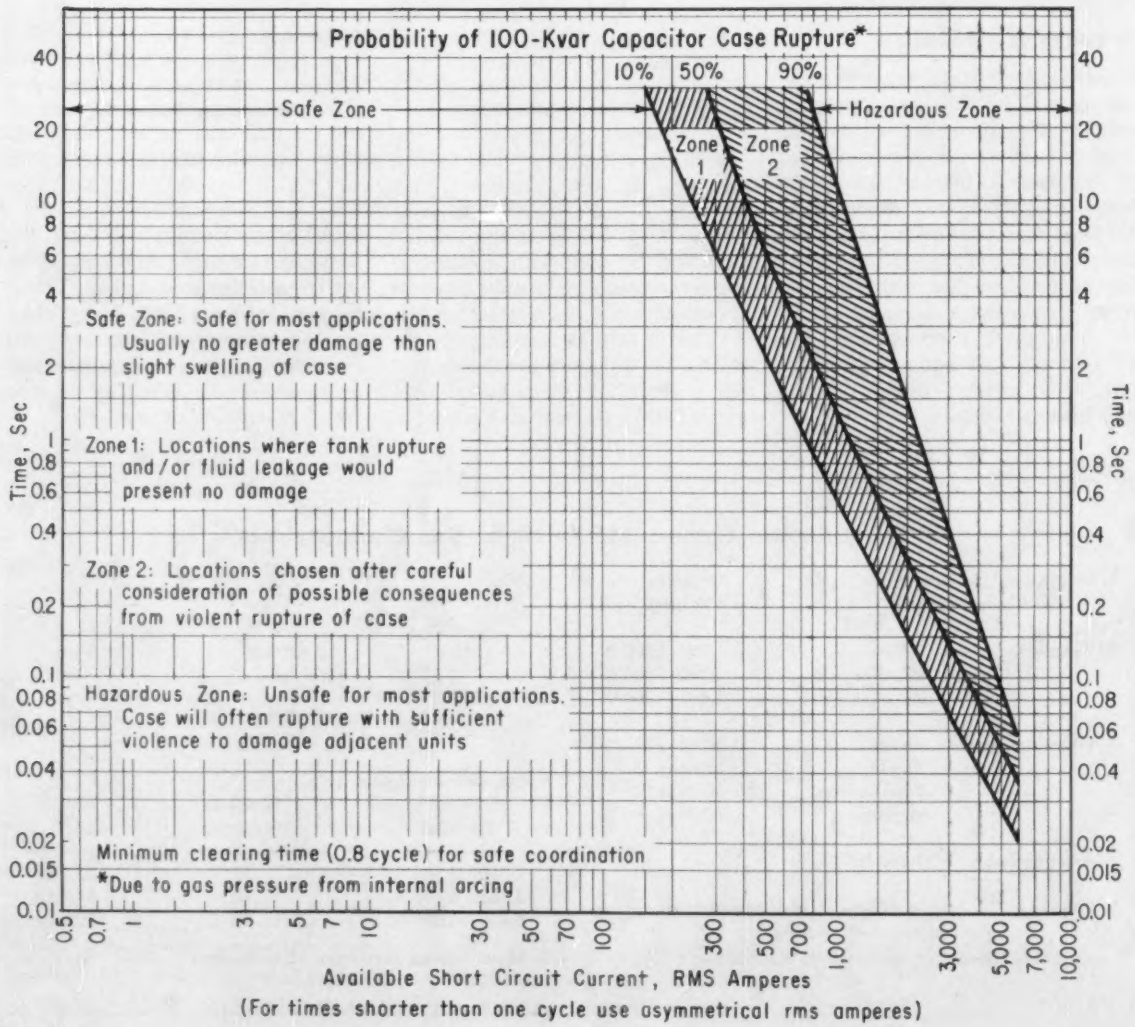
DON J. LEMENS, Engineer, Capacitor Systems, Line Material Industries, McGraw-Edison Co, Milwaukee, Wis.

A trend toward the use of the 100-kvar capacitor unit suggests the development of tank-rupture curves to aid in the optimum selection of fuse links for group fusing of these larger units. Based on these curves, fusing recommendations for both ungrounded and grounded capacitor banks have been established.

The curves for 100-kvar units are similar to those tank-rupture curves included in NEMA power capacitor standards since 1957 for 25-kvar and 50-kvar units. These latter curves have proved very useful in the application of group fused capacitors. With these curves, fuse link selection is based on the probability of tank rupture and the maximum clearing time of the link.

Accompanying curves for the 100-kvar unit have been verified by laboratory tests. It is particularly significant that the curves are shifted to the right as compared to existing 50-kvar curves. This shift permits the use of larger kvar installations with no greater probability of tank rupture.

Fusing recommendations of the author's company for group fusing of banks of 100-kvar units are listed in Tables I and II. On grounded-wye and delta banks, it is recommended that the maximum available



Capacitor Units Using Tank-Rupture Curves

fault current which can flow through a faulted unit be limited to 6,000 amp rms. In comparison, the recommendations for the 25-kvar and 50-kvar units are 4,000 and 5,000 amp rms, respectively.

This, briefly, is the reasoning used to determine the fusing recommendations: it is necessary to (1) minimize the hazards to personnel and adjacent equipment from possible violent rupture of a capacitor unit; and (2) protect the system from outages by removing the capacitor bank in the event of a failed unit or an external fault.

To meet these requirements and to provide satisfactory service, the fuse must have adequate interrupting capacity to handle the available fault current. It must also have a continuous current rating of 135% of nominal capacitor bank current and must withstand transient inrush currents upon capacitor bank energizing or de-energizing. These currents can be of large magnitudes, particularly when parallel capacitor banks are on the same distribution circuit.

In the case of ungrounded-wye banks, the fault current will be only three times normal line current. Therefore, the fuse link must melt and clear the circuit within 5 min at 285% of normal line current. The selection of K or T fuse links depends largely on the user's protection practices.

Table I — Group Fusing Recommendations for Ungrounded-Wye Banks
100-Kvar Units, EEI-NEMA T and K Links

3-Phase	2.4/4.16Y		2.775/4.8Y		4.16/7.2Y		4.8/8.32Y		7.2/12.47Y		7.62/13.2Y		7.96/13.8Y	
Kvar	Amp	Link*	Amp	Link*	Amp	Link*	Amp	Link*	Amp	Link*	Amp	Link*	Amp	Link*
300	41.7	40(0)	36.1	40(0)	24	25(0)	20.8	20(0)	13.9	15(0)	13.1	12(0)	12.6	12(0)
600	83.3	80(2)	72.2	80(2)	48.1	50(1)	41.7	40(0)	27.8	25(0)	26.2	25(0)	25.2	25(0)
900	125	140(2)	108	100(2)	72.1	80(2)	62.5	65(1)	41.7	40(0)	39.4	40(0)	37.7	40(0)
1,200	166	—	144	140(2)	96	100(2)	83.3	80(2)	55.5	50(1)	52.5	50(1)	50.3	50(1)
1,500	208	—	180	—	120	140(2)	104	100(2)	69.5	65(1)	65.7	65(1)	62.8	65(1)
1,800	250	—	216	—	144	140(2)	125	140(2)	83.3	80(2)	78.8	80(2)	75.3	80(2)
2,000	292	—	253	—	169	—	146	140(2)	97.3	100(2)	91.7	100(2)	88	80(2)
2,400	333	—	289	—	193	—	167	—	111	100(2)	105	100(2)	100.5	100(2)

*Both types T and K in each case

Tank Rupture Probabilities: (0) Safe zone: Below 10%; (1) Zone 1: 10-50%; (2) Zone 2: 50-90%.

Table II — Group Fusing Recommendations for Grounded-Wye and Delta Banks
100-Kvar Units, EEI-NEMA T and K Links

	2.4△		4.16△		4.8△		7.2△		8.32△		12.47△		—		13.8△	
3-Phase	—		2.4/4.16Y		2.775/4.8Y		4.16/7.2Y		4.8/8.32Y		7.2/12.47Y		7.62/13.2Y		7.96/13.8Y	
Kvar	Amp	Link	Amp	Link	Amp	Link	Amp	Link	Amp	Link	Amp	Link	Amp	Link	Amp	Link
300	72.2	80T(1)	41.7	40T(0)	36.1	40T(0)	24	25T(0)	20.8	20T(0)	13.9	15T(0)	13.1	12T(0)	12.6	12T(0)
		80K(0)		50K(0)		40K(0)		30K(0)		25K(0)		15K(0)		15K(0)		15K(0)
600	144	140T(2)	83.3	80T(1)	72.2	80T(1)	48.1	50T(0)	41.7	40T(0)	27.8	25T(0)	26.2	25T(0)	25.2	25T(0)
		200K(2)		100K(0)		80K(0)		65K(0)		50K(0)		40K(0)		30K(0)		30K(0)
900	216	—	125	140T(2)	108	100T(2)	72.1	80T(1)	62.5	65T(0)	41.7	40T(0)	39.4	40T(0)	37.7	40T(0)
		—		200K(2)		140K(1)		80K(0)		80K(0)		50K(0)		50K(0)		50K(0)
1,200	289	—	166	—	144	140T(2)	96	100T(2)	83.3	80T(1)	55.5	50T(0)	52.5	50T(0)	50.3	50T(0)
		—		—		200K(2)		140K(1)		100K(0)		65K(0)		65K(0)		65K(0)
1,500	361	—	208	—	180	—	120	140T(2)	104	100T(2)	69.5	65T(0)	65.7	65T(0)	62.8	65T(0)
		—		—		—		200K(2)		140K(1)		80K(0)		80K(0)		80K(0)
1,800	433	—	250	—	216	—	144	140T(2)	125	140T(2)	83.3	80T(1)	78.8	80T(1)	75.3	80T(1)
		—		—		—		200K(2)		200K(2)		100K(0)		100K(0)		100K(0)
2,100	505	—	292	—	253	—	169	—	146	140T(2)	97.3	100T(2)	91.7	100T(2)	88	80T(1)
		—		—		—		—		200K(2)		140K(1)		140K(1)		100K(0)
2,400	578	—	333	—	289	—	193	—	167	—	111	100T(2)	105	100T(2)	100.5	100T(2)
		—		—		—		—		—		140K(1)		140K(1)		140K(1)

Tank Rupture Probabilities: (0) Safe zone: Below 10%; (1) Zone 1: 10-50%; (2) Zone 2: 50-90%.

Pole-Line Bonding and Grounding

Corrections follow tests that duplicate operating conditions for pole-top distribution units to reveal voltage sources

D. C. KEEZER, Senior Electrical Engineer,
A. E. HENDERSON, Senior Substation Engineer, Pacific Gas & Electric Co, San Francisco, Calif.

Grounding capacitor cases and bonding the control circuits to capacitor racks has halted a rash of pole-top-capacitor switch failures on Pacific Gas & Electric Co's 12-kv, 3-wire, grounded-wye distribution system. Switch damage was caused by 60-cps and 2-Mc overvoltages on the switch control circuits. Grounding the capacitor cases eliminated a 60-cps overvoltage that approached line-to-ground potential—7.2 kv in this case—imposed on the low-voltage control circuits by non-simultaneous operation of switches on ungrounded wye and delta banks.

However, grounding capacitor cases did not eliminate a 2-Mc transient voltage—up to 8 kv—which appeared between control leads and the grounded switch tanks for a few microseconds after the first switch was closed. This transient was reduced to 2 kv by bonding the control-lead neutral to the capacitor rack. Most modern switches can withstand 2 kv indefinitely; but, to permit use of switches with a lower impulse level, a 0.1-μfd capacitor connected between each control lead and the rack further reduced the transient to less than 500 v.

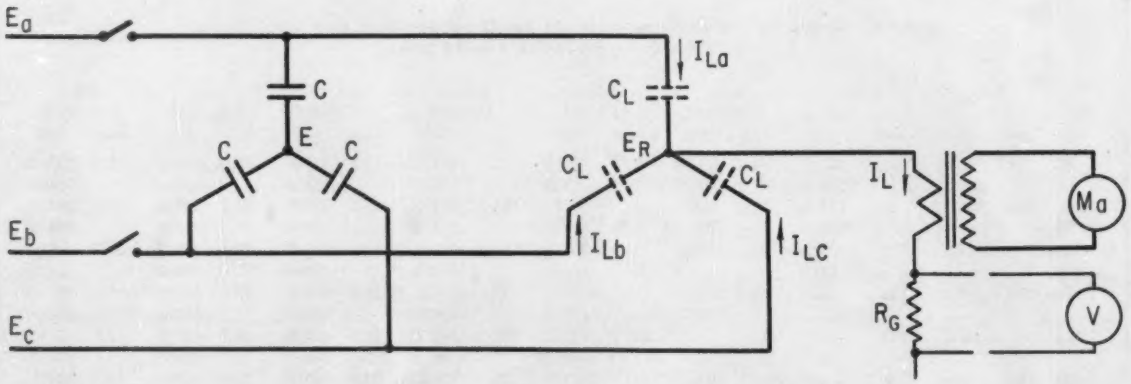
The neutral conductor is omitted on PG&E's 12-kv, 3-wire feeders, which are supplied by grounded-wye transformer banks. This realizes substantial economies in construction and permits relatively long extensions of any two of the phase conductors as single-phase laterals. It also avoids the possibility of severe phase-to-neutral conductor faults inherent in 4-wire systems.

During the past 40 years, this system has demonstrated flexibility in serving various load densities and it has been relatively trouble-free. But ground currents resulting from operation of certain types of pole-top equipment flow through the ground-return path plus the resistance of a wood pole, or impedance of a ground wire, and the contact resistance of a driven ground. Unless special precautions are taken, the flow of minor ground currents can develop pole-top-to-ground potentials capable of damaging low-voltage control circuits.

A few years ago, PG&E installed 33 12-kv switched capacitor banks in ungrounded racks to comply with California Rules for Overhead Line Construction as then interpreted. The banks were rated 300 or 600 kvar, 12.47-kv ungrounded wye, and were installed at the same time under similar climatic conditions. Within a month after completion of the job, several of the oil switches had ceased to operate; within eight months, 25% of the switches had failed and were replaced. Inspection traced the malfunctions to punctured insulation in the 120-v control circuit.

The source of the destruction voltage can be readily identified with the aid of the simplified schematic diagram below. The combination of pole resistance, R_G, and leakage capacitance, C_L, in series between the phase conductors and ground acted as voltage divider. Because the pole resistance was large compared to leakage reactance, the greater part of the line-to-ground potential appeared across the resistance (rack-to-ground). This potential was impressed across the control circuit, one side of which was grounded.

To determine the voltage produced by leakage current from a typical pole-top capacitor bank, PG&E installed a 300-kvar, 12-kv switched capacitor in its test yard under conditions duplicating those in the field, except that the capacitor

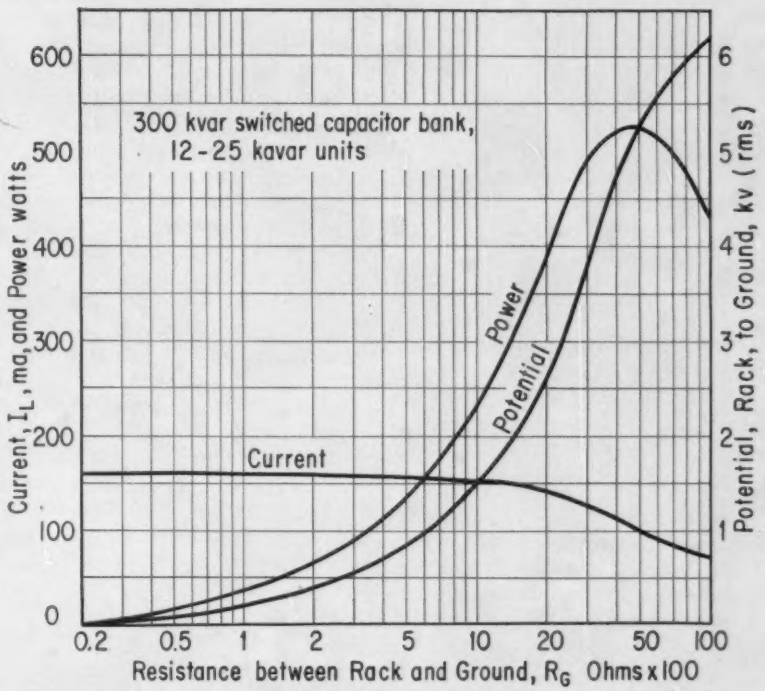


C Bushing-to-bushing capacitance per phase
C Leakage capacitance to case (rack) per phase
R Resistance from rack to ground
Ea, Eb, Ec, Phase voltage
E Potencial from neutral to ground
E Potencial from rack to ground
I Total current through leakage capacitances
$I = I_{La} + I_{Lb} + I_{LC}$

HIGH VOLTAGE APPEARED across pole resistance, R_G, and leakage capacitance, C_L, which acted as voltage divider

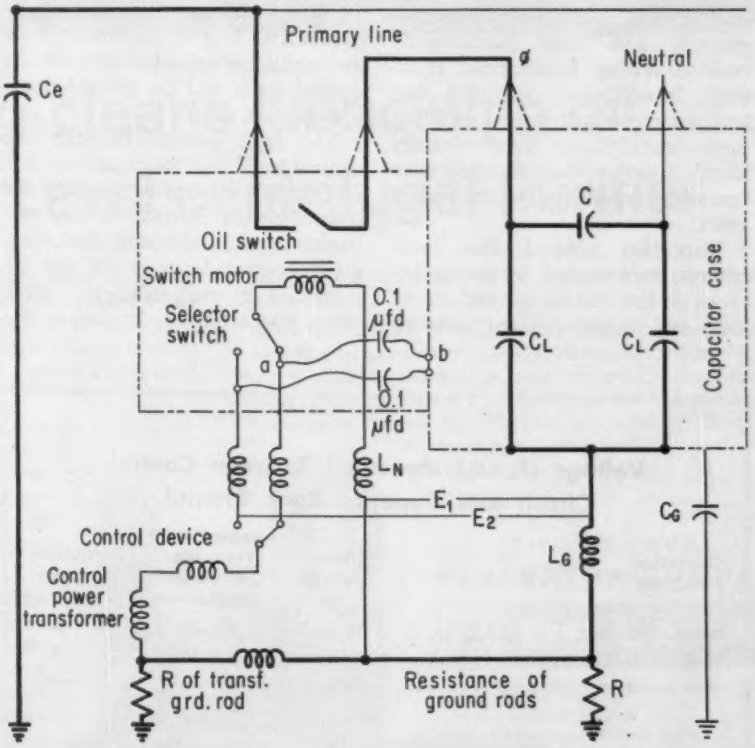
Halt Capacitor Switch Failures

rack was insulated from the pole. The rack was connected to ground through a variable resistor to simulate normal variations of pole resistance caused by moisture and surface contamination. By varying the resistance in known steps and measuring the current and voltage drop (see schematic), data were obtained from which rack-to-ground power flow was computed. The results of this test are shown in the curves. With only one phase energized, the voltage between rack and ground exceeded 6 kv throughout the normal range of pole resistance. Although small by comparison with the main bushing-to-bushing capacitance, C, the leakage capacitance, C_L, conducted appreciable current and power, as shown by the test curves. With two phases energized, the values obtained were approximately half those shown by the curves for one phase energized.



TESTS THAT SIMULATED LINE CONDITIONS yielded these curves of voltage, current and power from capacitor rack to ground. One phase was energized

HIGH FREQUENCY TRANSIENT caused by capacitor-switch operation discharged through the heavy path and induced an overvoltage in the control leads

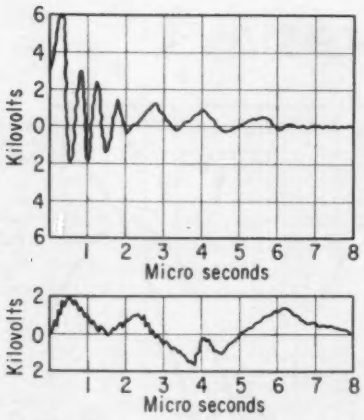


Open Phase Voltage Source

When either one or two phases of the capacitor bank were de-energized, primary voltage appeared on the low-voltage control circuit of the oil switches. Its duration varied from perhaps several days in the case of a blown fuse to the few cycles difference in operating time of the electrically controlled oil switches. Oscillograms show the occurrence of this condition during the normal automatic opening and closing of the switches, with approximately 50 to 100% of circuit line-to-ground voltage being impressed directly across the 600-v insulation of the low-voltage control mechanisms and lead wires for several cycles. Such repeated overstressing of switch control circuits on ungrounded 12-kv capacitors produced early failures.

No switch failures occurred on 4-kv capacitors but it is probable that failures would have occurred after the insulation level of the control circuit had deteriorated by chemical action over a long time and by contamination.

Following these tests and operating experience, PG&E obtained another interpretation of the California Rules for Overhead Line Construction which permitted



UPPER OSCILLOGRAM A shows 2-Mc transient before bonding. Lower Trace B shows effect of bonding control-circuit neutral to the capacitor rack

grounding the racks of all pole-top switched capacitor banks. Oil-switch failures ceased immediately after installation of the grounds and this problem was apparently solved.

New Failures Spur Tests

Further troubles occurred many months later when a new switch similar to those already in use, failed during initial tests. Within a week eight had failed in service. From external symptoms, it appeared probable that the rack grounds had been inadvertently omitted during installation. However, investigation disclosed that both racks were grounded and that these installations were virtually identical to the others that had been operating satisfactorily for several years.

Inspection showed that these failures were caused by arcing between the low-voltage control-circuit leads and grounded metal parts inside the switch control housing. It was evident from the spacing of the parts which had flashed over that a voltage much higher than the normal 120 v had been developed between control leads and grounded rack.

Preliminary tests, using equipment suitable for low-frequency measurements only, established that there was no sustained 60-cps high voltage present but indicated the presence of a relatively high voltage of very short duration. After a careful study of the capacitor bank and its associated circuits, the high voltage was tentatively identified as a high-frequency transient produced by discharge of the line-to-ground capacitance through the capacitor bank and the inductance of the rack ground lead.

As shown in the diagram on the previous page, the discharge path for the energy stored in effective line-to-ground capacitance, C_e, is through the leakage capacitance, C_L, in series with the rack ground-lead inductance, L_G. The initial voltage impressed on this circuit, i. e., the voltage across C_e, could be any value between zero and the peak line-to-ground voltage, depending on the point in the cycle at which the first oil switch closed. The sudden discharge of C_e through this circuit when the capacitor oil switch closes produced a damped high-frequency oscillation. The voltage induced by the oscillation appeared between the control leads and the grounded capacitor rack (E_1 or E_2).

The high voltage between the control leads and the capacitor rack was greatly reduced by bonding the control-circuit neutral to the capacitor rack. Although the energized control leads could not be grounded to the rack, the same effect was achieved, insofar as the high-frequency transient was concerned, by connecting small capacitors (approximately 0.1 μfd) between these control wires and the capacitor.

To determine the magnitude and frequency of the transient voltage, a series of tests was made on two 12-kv and one 4-kv switched capacitor banks. An oscilloscope was used to record the voltages. Input to the oscilloscope was obtained from a frequency-compensated voltage divider connected to a switch to avoid disturbing the physical configuration of the control or rack grounds.

Oscilloscope Catches Transient

The table shows the results obtained with and without the bond and the capacitors. These are the maximum values recorded in a large number of tests and probably represent the condition in which the 60-cps voltage was at or near its peak value when the oil switch closed.

Virtually identical results obtained on a 150-kvar, 12-kv capacitor bank indicate that the magnitude of the transient voltage is relatively independent of bank size. Oscillogram A is a typical oscillogram of the voltage measured between the control leads and rack without the control-circuit neutral bonded to the rack. Two frequencies are present, the higher one having a much greater amplitude. Trace B is from the same capacitor bank with the control neutral lead bonded to the rack. All other operating conditions were the same. The bond reduced the magnitude of the higher-frequency component of the transient but had little effect on the low-frequency component. Connection of a 0.1 μfd capacitor between the energized control lead and the capacitor rack reduced both components to less than 500 v.

PG&E is now planning to install ground-fault detection on all switched capacitor banks. Since these detectors will be actuated by current flow in the capacitor-rack ground lead, the metallic bond connection from the control neutral lead to the rack must be omitted to avoid diversion of part of the ground current around the detector. An additional 0.1 μfd capacitor will be substituted for the metallic bond and will provide essentially the same reduction in transient voltage.

Voltage (E_1, E_2) Measured Between Control Circuit and Capacitor-Rack Ground

Operating Condition	Peak Voltage	Approximate Frequency of Major Component	Oscillogram
Without bond	8 kv	2. Mc	A
With bond	2 kv	0.2 Mc	B
With bond and capacitor	500 v	———	———

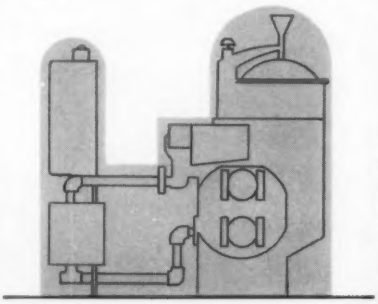
Nothing cleans lubricating oil like a De Laval centrifugal Purifier

Ordinary filter systems serve adequately until something really goes wrong. Then, only a centrifuge can restore turbine oil to proper dryness and cleanliness. Why not put centrifugal purification directly into your routine by-pass system on a full time basis and be prepared for all types of emergencies at *any* time?

The "UNI-MATIC" is a complete oil purification unit including all necessary pumps, heaters and control equipment. It continuously removes water and solids and is so efficient and dependable that even after water leaks are discovered, turbines have been left in operation until shut-down is convenient.

Coupled with a filter unit, it becomes the De Laval PURI-FILTER which removes colloidal carbon down to one micron in size. Oil additives are unaffected by centrifugal purification although sludge and moisture are removed with an efficiency that no other system can match. Installation on either turbine or diesel lube oil systems permits one point operator supervision.

MORE ECONOMICAL TO INSTALL AND OPERATE: The De Laval UNI-MATIC or PURI-FILTER systems eliminate the need for a stand-by centrifuge, and are much more compact than all-filter purifiers. Full details on the low-maintenance features of typical installations are given in descriptive literature which will be sent at your request.



THE DE LAVAL SEPARATOR COMPANY

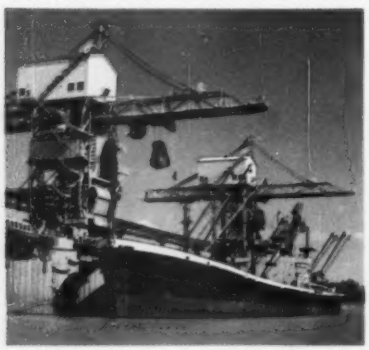
DE LAVAL

Poughkeepsie, New York
5724 N. Pulaski, Chicago 46, Ill.
201 E. Millbrae Ave., Millbrae, Calif.

How Dravo serves utilities

MATERIALS HANDLING

New 800-ft. multi-purpose dock and twin unloaders service both ships and barges at a 2,000 ton-per-hour rate. Check coupon at right for information on Dravo's bulk material handling equipment and economical cellular docks.

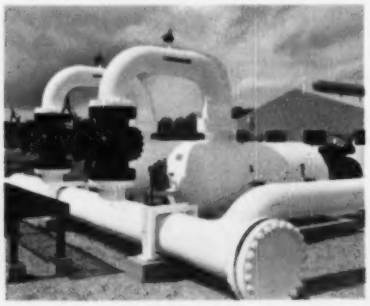


GENERATING STATIONS

In addition to large conventional and nuclear generating stations for public utilities, Dravo has built numerous smaller scale stations for industrial plants. Intakes and foundations for such installations are also Dravo specialties, as well as fabrication and erection of station piping, including nuclear applications. Mail coupon for more details.

CONSTRUCTION

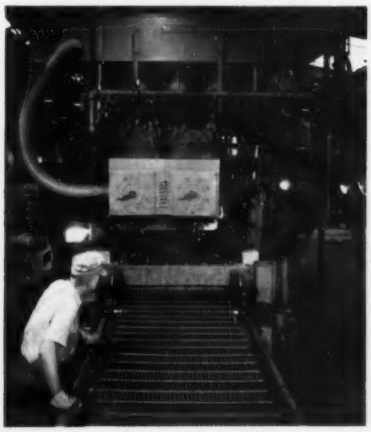
This compressor station is one of many contracts performed on a turn-key basis. Process, air separation and boiler plants, slopes, shafts, water pumping and treating facilities are part of Dravo's specialized experience. Mail coupon at right for more information.



High pressure piping being removed from heat treating furnace in Dravo's modern pipe fabrication plant.

GRATING

Tru-Weld steel grating for floors and stairways is produced in one of the nation's most modern facilities. Aluminum grating can be furnished where weight or atmospheric conditions require. Engineering, design and layout services are available for installation requirements. Mail coupon for complete details.



TOWBOATS AND BARGES

New high speed 3200-hp towboats, operating in petroleum trade, typify the variety of marine units produced yearly. Dravo has launched more than 4,000 towboats, barges, tugs, dump scows, derrick boats, dry docks, other marine units. Mail the coupon for information.

Dravo Corporation, 4762 Grand Avenue, Pittsburgh 25, Pa.

Please send me information on the following products and services

☐ Sinter & Pelletizing Plants	☐ Foundations	☐ Fabricated Piping
☐ Pumping Stations & Intakes	☐ Grating	☐ Container Cranes
☐ Sewage & Water Treatment	☐ Space Heaters	☐ Pelletizing Discs
☐ Coal & Ore Unloaders	☐ Shafts, Slopes	☐ Process Machinery
☐ Compressor Stations	☐ Oxygen Plants	☐ Steam Plants
☐ River Transportation	☐ Docks, Harbors	☐ Towboats & Barges

Name_____ Title_____

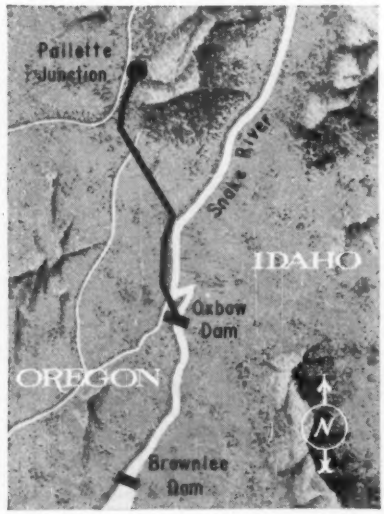
Company_____

Address_____

City_____ Zone_____ State_____

DRAVO

Steel Goes Up From Oxbow To Pallette



Idaho Power builds section of 230-kv line linking Snake River hydro development with other members of Northwest Power Pool

The raging Snake River twists and turns for a good many miles through the Hells Canyon reach between Idaho and Oregon. Men have long dreamed of harnessing its might to generate power for the Northwest. Only recently, with completion of Idaho Power Company's hydroelectric project at Brownlee, did that dream become reality.

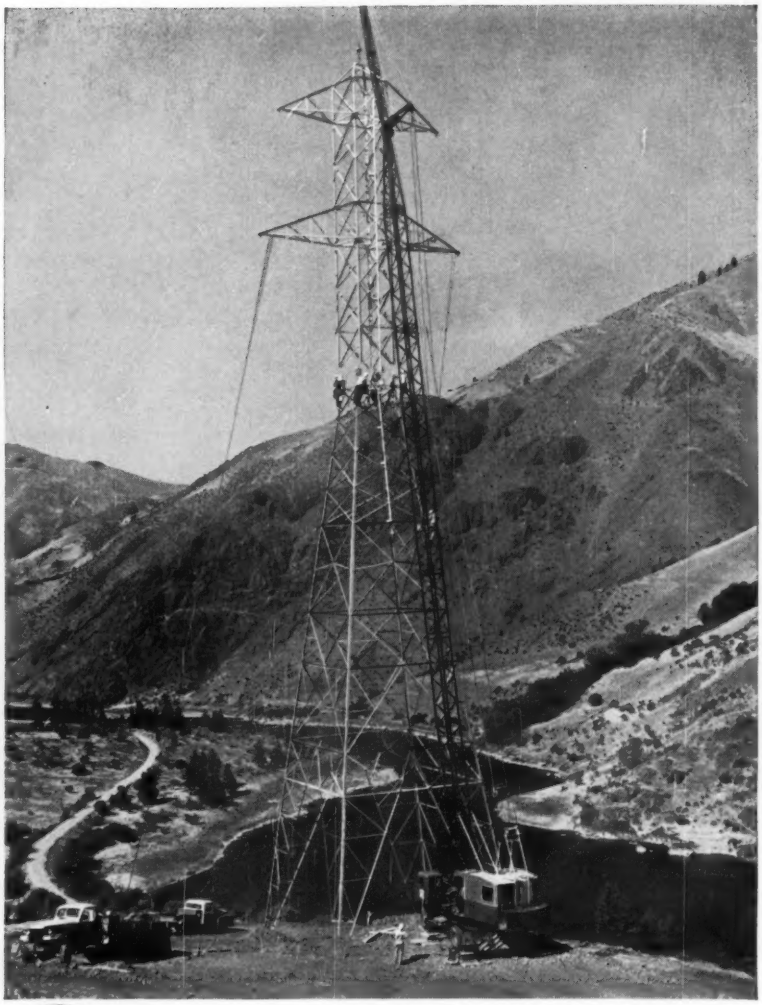
There's more to come. About twelve miles north of Brownlee, where the Snake makes an abrupt hairpin turn known as the Oxbow, another hydro development is fast taking shape. And to transmit Oxbow's 200,000-kw output, Idaho Power Company has been putting up steel towers and stringing wire in some of the wildest terrain in the nation.

OXBOW TO PALLETTE . . . The 20.5 miles of steel-tower line from Oxbow to Pallette Junction is part of a third high-voltage link between Idaho Power's Snake River development and other members of the Northwest Power Pool. The utility's crews had to make like mountain goats to put up steel and string conductor on sites ranging from an elevation of 1,800 ft at Oxbow to 5,470 ft, then down to 3,550 ft in the Imnaha River Valley.

96 TALL TOWERS . . . The job was made easier by careful bundling of components for each individual tower at Bethlehem's Seattle and South San Francisco tower shops. That's vital when you're working inaccessible sites. The double-circuit galvanized structures ranged in height from 102 to 145 ft, practically all with sidehill leg extensions. Spans averaged 1,130 ft, with the longest being 2,593 ft. Idaho Power and Bethlehem handled tower design jointly.

THREE SHOPS . . . West of the Rockies, you can't beat Bethlehem's Seattle and South San Francisco tower shops for fast, skillful service in fabricating towers and substation structures. We serve the rest of the nation from Leetsdale, Pa., (near Pittsburgh), probably the world's most experienced tower shop.

The nearest Bethlehem sales office can give you further information. Don't hesitate to call!



A long-boomed Idaho Power truck crane eases an entire top section into place. The Snake River and Idaho hills form the backdrop.

Steel *for Strength . . . Economy . . . Versatility*

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Flexible Demand Register Cuts Metering Cost

D. M. HAM, Development Engineer, Meter Dept, General Electric Co, Somersworth, N. H.

Extended registration range achieved by use of a kwhr-type 3-dial register for demand readings, and easy conversion by a gearing shift to any of three demand periods, offer utilities significant savings in metering time and expense. Demand values displayed on conventional-type meter dials expedite accurate reading and billing. And the three dials on the decade gear train provide a scale equivalent to 160 in. of conventional single-pointer scales, thus giving it sufficient operating range to match any meter on which it may be installed.

Meters with the new register are easily checked by manually resetting the demand system, spinning the common take-off until the dial registers 1 kwhr, and reading the kw dial. The latter will show 1 kw if the meter is set for a 60-min interval, 2 kw for 30 min, or 4 kw for 15-min.

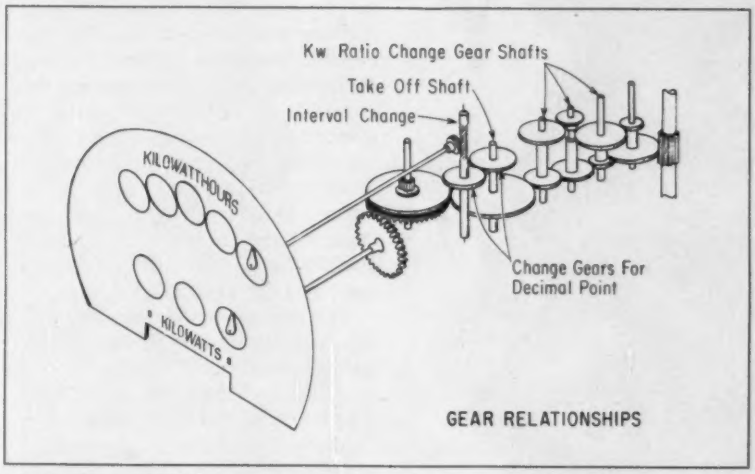
The direct relation between the ratio gearing of the two registers permits gearing from the disk shaft to the kw register to drive the kwhr register also. Because the kw register usually runs faster than the kwhr register, the ratio change gears were designed to drive a common takeoff shaft at the correct speed for the first kw dial. A worm driven by the takeoff shaft drives the first dial of the kwhr register.

Gear Change Sets Period

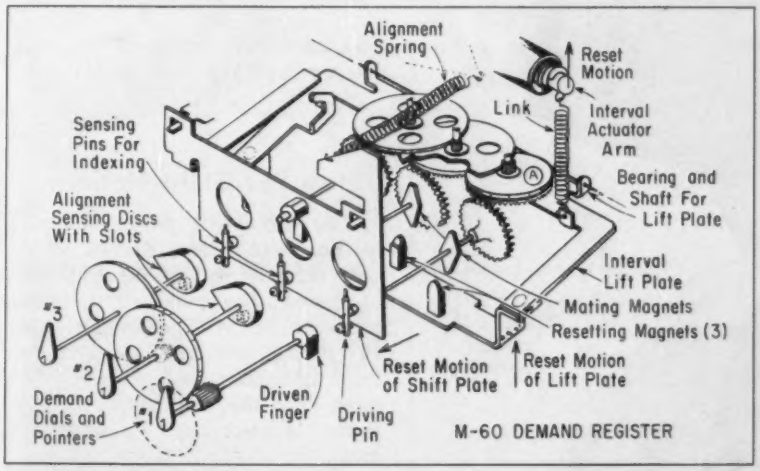
The multiplier for both registers, as well as a 2:1 speed-up for 30-min or 4:1 for 15-min demand intervals, is introduced by interchanging gears in the common gear train. Kwhr dial speeds are restored to normal for the 30 and 15-min demand gearings by replacing the single pitch worm with double or quadruple, respectively.

Direct coupling must be maintained at all times for the kwhr register. But the demand register drive must be uncoupled, reset, and coupled automatically at the end of each demand interval without affecting readings on its dials. This is achieved by placing a running register between the gear train's takeoff shaft and the kw dial register, so that the running register measures the demand of each interval and engages the dial register whenever the running register passes the dial register's previous maximum reading. The two demand registers then advance together until the end of the interval when the running register gets reset to zero.

The running register comprises three decade-geared vertical shafts, each of which drives through 1:1 crown gears a horizontal shaft carrying a pin arm at its outer end. These horizontal shafts are aligned with the corresponding shafts of the kw dial register, two of which carry notched disks on the facing end



KWHR AND KW REGISTERS drive from common takeoff shaft so that ratio changes in driving gear chain adapt both registers to metering application



PERIODIC RESET disengages running register's pin-arm shafts from dial register and from crown gears, permitting magnets to align shafts at zero position

while the third or unit shaft has a pusher dog.

Coupling of the running register to the dial register occurs only when the tens and hundreds pin arms reach positions corresponding to notches in the corresponding disks, thus permitting the spring-loaded bearing block to push them into the notches and engage the units-shaft pin arm with the dial register's pusher dog. Inasmuch as the dial register remains at the last previous demand setting, only a new interval demand exceeding the previous ones can cause coupling of the registers to further advance the dial.

Periodic reset is accomplished by an upward stroke of a hermetically-sealed motor-driven actuator. This stroke raises three magnets into close proximity to a re-setting magnet on each shaft of the running register and swings the bearing block to disengage all three running shafts from the dial register and the crown gears so they are free to respond to the magnetic reset. De-energizing the actuator drops the re-setting magnets and permits the bearing block to swing forward, re-engaging the crown gears and re-establishing contact between the pin arms and the notched disks.

This pointer-pusher memory system, despite its low driving torque and magnetic reset, has been found to cause less than 1% error from 5 to 100% of full-scale registration.

Manual re-setting of the demand register first, by a cam, disengages the running register from the notched disks and pusher dog. Continued movement engages a spring-loaded sector gear with each pointer shaft and rotates it to the zero position, over-riding spring clutches on the tens and hundreds gears.

British Eye Giant Stations

Two 2,000-Mw power stations in Yorkshire, Great Britain, need only the approval of the Minister of Power. The coal-fired stations, to be built in Eggborough and Ferrybridge, have been approved by local authorities, and planning will move into the final stages if the Power Minister adds his endorsement.

Each station would burn up to five-million long tons of coal a year.

"Joe, we plan to specify Anderson products on that new transmission line..."

"Anderson? What changed your mind?"

Selling

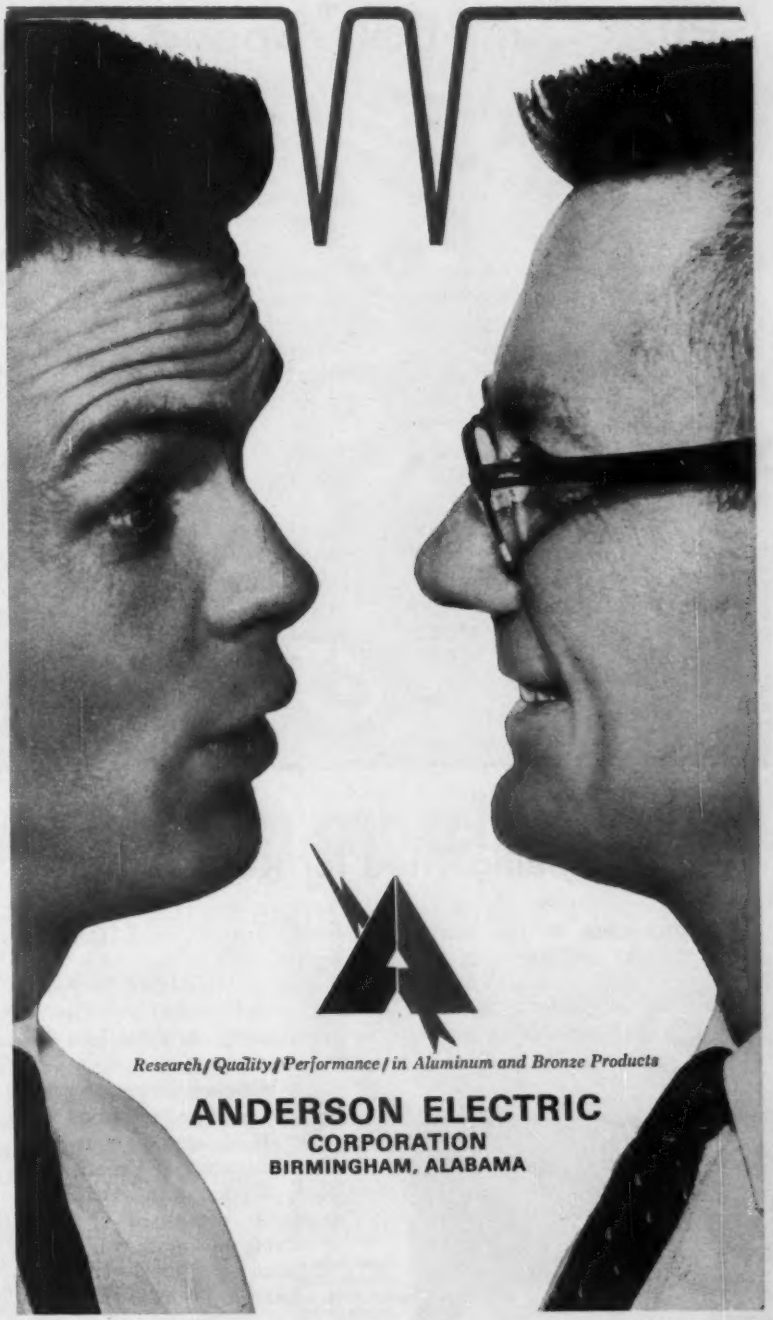
An electric home heating rate of 1.65¢ per kwhr, compared to 1.8 to 2.0¢ under the company's present residential rate schedule, has been filed with the Pennsylvania Public Utility Commission by Pennsylvania Power & Light Co. The new rate will become effective September 1. Company now has more than 700 electric heat customers on the lines . . . **A group of citizens** has charged that Georgia Power Co discriminated against them when the company put its residential wiring plan into effect last year. Group contended that they paid for wiring of their homes before the plan was put into effect, and customers who have since participated in the plan have received cash bonuses for having their homes wired. This has the effect of lowering rates for those customers, the group complained. Georgia Power counsel told the Public Service Commission that the wiring plan is perfectly legal and was explained in detail at the time the commission approved it. Company said a survey made before the plan was offered showed that most Georgia homes were not adequately wired, and that also the plan had to start at some point and Jan. 1, 1960, was chosen.

An elaborate display which is in effect a whole house has been erected in Detroit, Mich., to help builders better merchandise their homes. The Michigan District of General Electric Co's Sales and Distribution Department set up the house in its Detroit Warehouse to illustrate to builders, heating contractors, electrical contractors, plumbers, utility commercial sales representatives and home buyers the features and advantages of Medallion Homes. "One visit to the Medallion Home will be more beneficial to members of all the related industries concerned with residential construction than a thousand letters and a dozen meetings," John Chariot, contract manager for the Michigan District, said.

Public response was so enthusiastic, all 390 units in the Cedonia garden apartments in Baltimore, Md., will be totally electric. Original plans were to test public acceptance for electric heating in only ten units.

"Well, we tested 'em... Anderson clamps outperformed all others. And you know, of course, Anderson's facilities are self-sufficient ...and they're constantly coming up with new improvements..."

"Suits me! Anderson sure has the design, quality, service...and the competitive price we want, too!"



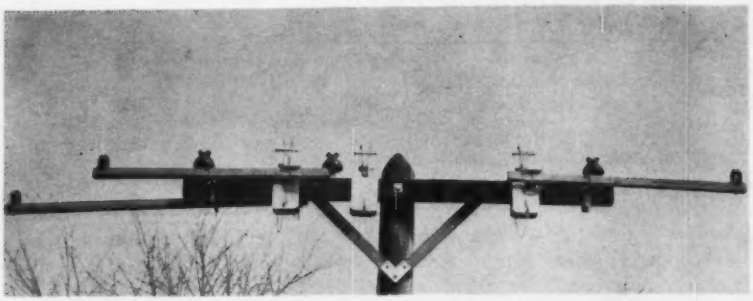
Research/Quality/Performance/in Aluminum and Bronze Products

ANDERSON ELECTRIC
CORPORATION
BIRMINGHAM, ALABAMA

ELECTRIC UTILITY METHODS

E u m

OPERATIONS & TESTING



'Push-Out Sticks' Speed Reconductoring

EDWARD VANDER VEEN, Asst Electric Distribution Supt, Grand Rapids Division, Consumers Power Co, Grand Rapids, Mich.

"Push-out sticks" are being used effectively by Consumers Power Co crews to spread energized distribution circuits safely while new conductors are being installed. During one of many times the sticks have been used, a half-mile of three-phase primary line was replaced in 4 hr without interruption of service.

For the replacement of a circuit which cannot be de-energized, three sticks are mounted on each crossarm for the full length of the primary pull. Two sticks are 54 in. long; the third is 72 in. long. Each, with an insulator on one end, rides in two brackets attached to the arm.

The inboard end of each stick slides through a U-shaped holder welded to the side of the running-block bracket for the incoming conductor. The outboard end of each stick rides in a special bracket on the arm. Holders and special brackets are designed so that the outboard conductor on one side of the pole (on the longer stick) is displaced both horizontally and vertically from the middle conductor (same side of the pole).

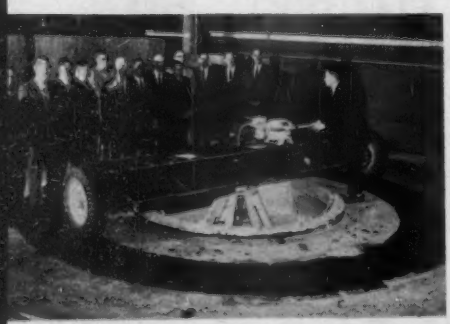
At the start of the operation, two linemen are assigned to each pole. They remain in position until the entire job is completed. Linemen untie the energized conductors from their insulators, temporarily tie them to the insulators on the push-out sticks, and then slide the sticks out to spread the conductors.

The new conductors are strung on the running blocks, pulled to sag and tied to the line insulators. The new line is energized in parallel with the old, and individual loads are transferred to the new line. After all loads have been transferred, the old wire is de-energized and removed.

The push-out sticks are held in their brackets with steel pins. To remove the old wire, the pins are pulled and the stick is removed from its bracket with the wire still secured to the insulator. By handling the stick, the lineman can lower the wire and bring it in toward the pole, after which he can then lower it to the ground.

'Fly Ash' Being Tried for Road Base

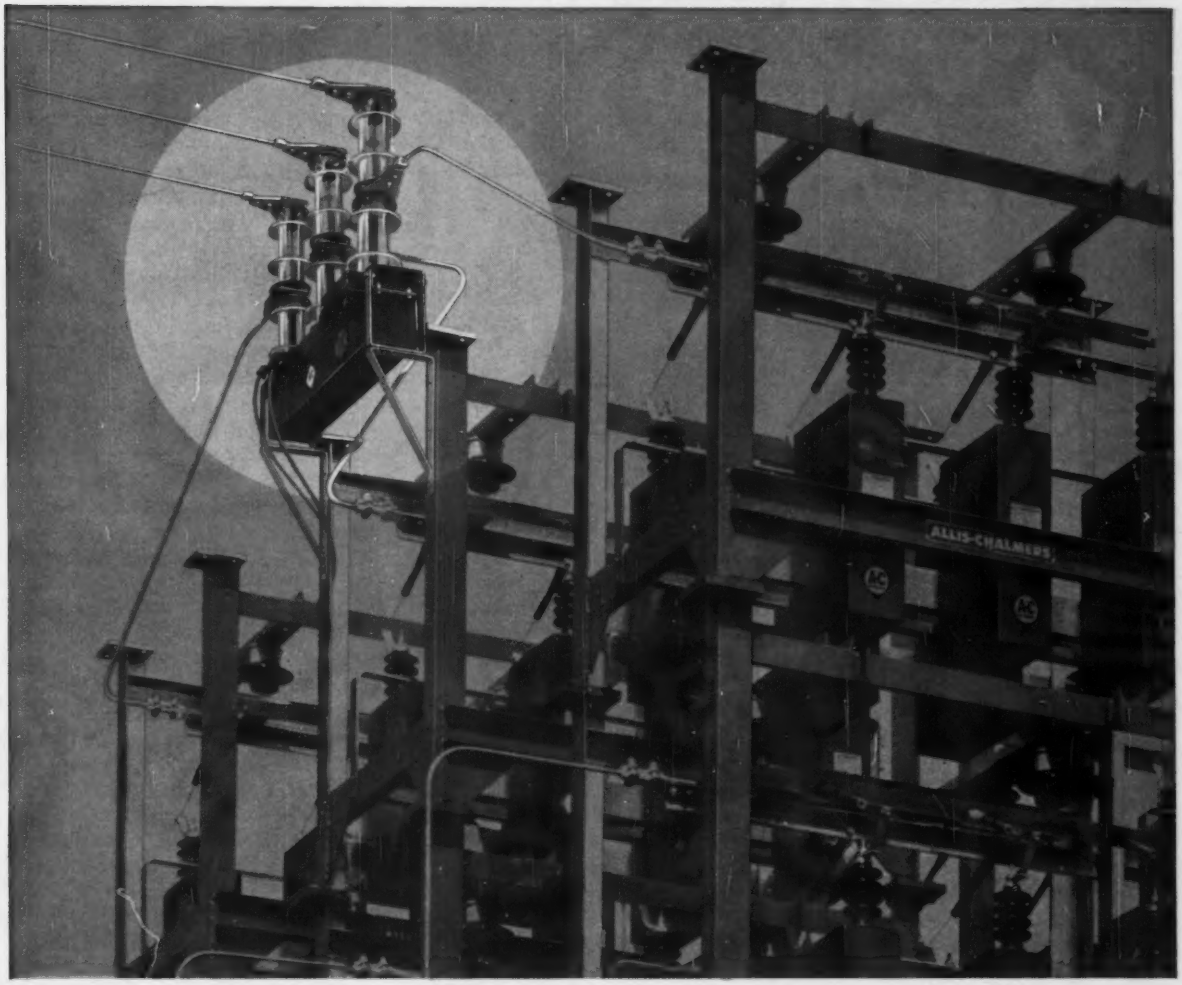
Improvement in the market for "fly ash" and slag is the objective of tests underway at the University of Illinois. The university's civil engineering department, working with Commonwealth Edison Co, has been testing the durability of Poz-O-Pac, a fly ash-slag-lime mixture, to determine its value as a road base material.



To compare various types of highway surface and road base materials, a circular test track was constructed at Urbana. The track, divided into several segments, is comprised of panels of varying thicknesses which have the same subgrade. "Traffic" is simulated by a pair of wheels, pivoting from the center of the track on the ends of a steel girder. These wheels pound the roadway for the equivalent of 1,000 trucks per hr.

Initial track tests, to set design standards, revealed after less than two months of operation that the lime-pozzolan mixture is more durable than other materials tested. It is expected that test data will result in the increased use of fly ash and slag for state and county secondary roads in Illinois.

ALLIS-CHALMERS



Now...a low-cost vacuum capacitor switch

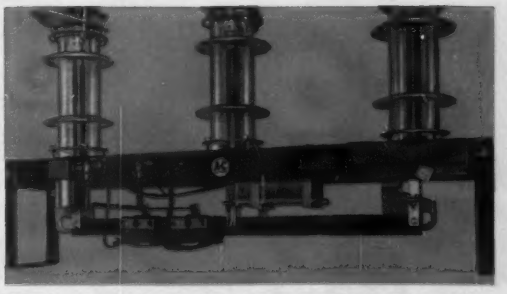
Restrike-free...lightweight...reliable

Competitive with conventional oil switches... this new 14.4-kv, 300-amp Allis-Chalmers three-phase vacuum switch is specifically engineered for capacitor duty. It operates from ac or dc, manually or by fully automatic control as the system demands. You get restrike-free performance, reliability and maintenance-free operation. Weight is one-third that of oil-type switches.

Resistance to physical damage is just as spectacular. Point-blank, 22-long rifle fire failed to penetrate the tough Plexiglas protective housing. The vacuum tubes withstood pressure tests in excess of 20 times normal closing forces.

For more information, contact your nearby A-C office. Or write **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.*

A-1409



How it works — Front view shows capacitor switch mechanism housing with cover removed. When coil is energized, solenoid plunger moves connecting rod through cam to close the contacts.

Capacitor 'Compacting' Fits 100 Kvar Into 50-Kvar Rack

A major breakthrough in "compacting" 50 and 100-kvar power capacitors was announced simultaneously last week by Federal Pacific Electric Co and General Electric Co. GE's "Unifilm 100"-kvar capacitor weighs 132 lb, occupies 2,050 cu in; FP's "Tiny Tim" 100-kvar unit weighs but 115 lb and occupies 1,716 cu in.

The recently announced decreases in weight and physical size are such that the 100-kvar unit of today is about the same weight and occupies about the same space as the 50-kvar unit of six months ago.

In the wake of GE's and FP's announcements, additional information on power capacitor "compacting" was brought to *Electrical World's* attention.

Capacitor sizes, of course, vary to a small degree within a particular kvar class, depending on the voltage rating. These small variations have not been referred to in the following review—in a general sense the 2,400 through 7,960-v range is the reference base. No quality comparison is attempted—in all instances industry standards are assumed.

Federal Pacific Electric Co—Sizes and weights 25% to 30% smaller than those of many available power capacitors are features of the new Cornell-Dubilier "Tiny Tim" 50- and 100-kvar power capacitors.

Federal Pacific's 50-kvar "Tiny Tim" weighs 62 lb, with overall dimensions of 4½X13½X23¼ in. (15 in. case height). This size allows use of the 50-kvar "Tiny Tim" in racks, designed for 25-kvar units. Similar economies are afforded by Federal Pacific's new 100-kvar "Tiny Tim" capacitor. This unit weighs 115 lb with case dimensions of 4½X13½X28¼ in. and an overall height of 36½ in. This reduction in size permits doubling of ratings on existing 50-kvar pole installations with slightly more than a one-third increase in weight. The "Tiny Tim" 100 is reported to be the only power capacitor that meets all NEMA "stack-rack" dimensions for 50-kvar power capacitors.

These units are rated at 2,400 volts through 7,960 v, 60 cycle, single phase, with single or double bushings. "Tiny Tim" capacitors are reported to retain features of previous Cornell-Dubilier power capacitors: low heat rise, low losses. All electrical, physical characteristics and mounting brackets "meet NEMA and AIEE standards."

General Electric Co—The new "Unifilm 100" capacitor, weighing 132 lb and occupying 2,050 cu in., reportedly produces more kvar per pound and cubic inch than any power capacitor previously available. The Unifilm 50 capacitor weighs 76 lb, occupies 1,188 cu in. (4X13½X22 in.).

According to department power capacitor engineering manager, R. J. Hopkins, "improvements are the result of considerable research and development which, during the past five years, have reduced capacitor size and weight 40% per kvar and have yielded improved capacitor performance and reliability."

A new GE single-row pole-type equipment rated 1,200 kvar is now about the same weight as GE's original 600-kvar equipment with 50's introduced in 1956. The extension beyond the pole is shorter for the new 1,200-kvar equipment than for the original 600-kvar equipment.

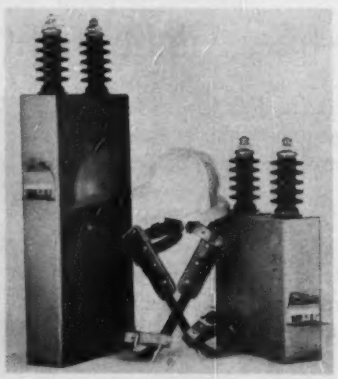
Unifilm 100 capacitors installed in substation banks are said to take up as little as 61% of the space required for a bank using racks with 50-kvar units. Also, since up to 30 new 100-kvar capacitors can be installed in one rack, 50% more kvar can be handled in one piece than was possible with 50-kvar units. In addition, equipments with 100's have only one-half the number of connections, bushings and fuses subject to periodic inspection as compared to racks employing 50-kvar capacitors.

GE reports that a new manufacturing development now produces a uniform film, ("Unifilm") of liquid dielectric between the sheets of paper and between the paper and foil in the winding. A reduction in average distance, but not minimum distance, between foils is said to result. Therefore, more capacitance (kvar) and effective use of space is realized. Improved "Isokraft" paper with a stated low and flat watt-loss vs temperature characteristic helps minimize heat generated in the capacitor.

Large case sides, 20X24 in., in the 100-kvar unit provide a substantial cooling area and a narrow width, 4½ in., assures a short heat path to a cooling surface. Impregnation with Pyranol liquid is said to produce an electrically strong di-

(*Continued on page* 72)

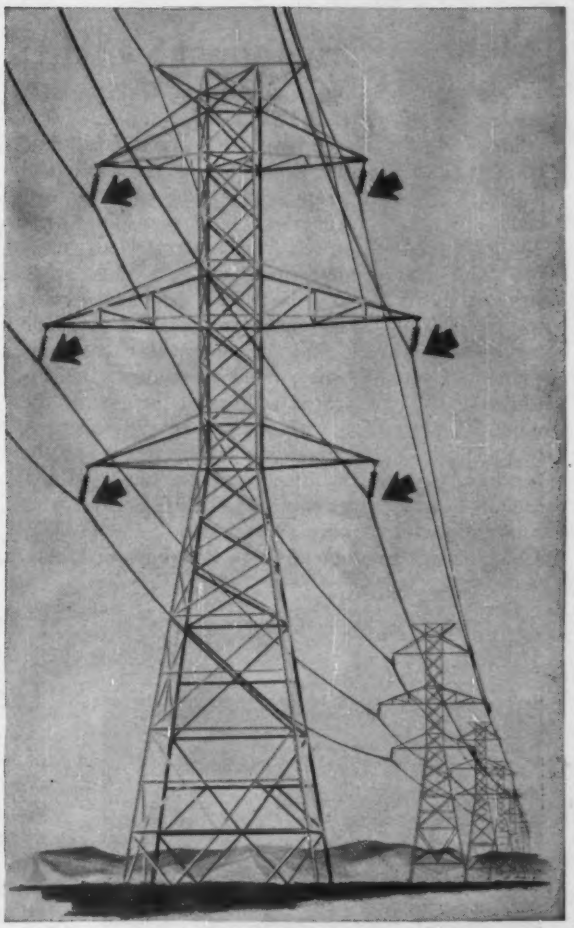
'UNIFILM 100' weighs less than two of the new lightweight 'unifilm' 50's

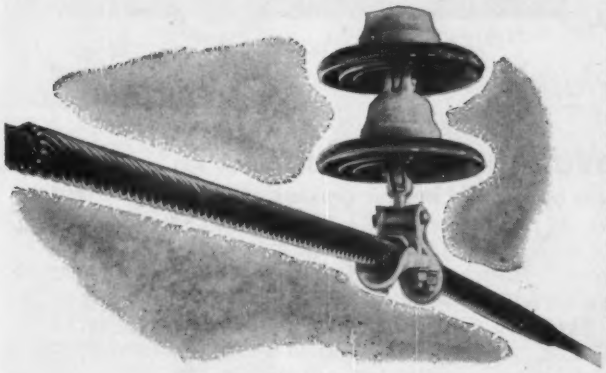


'TINY TIM 100' can replace single 50 with ⅓ increase in weight

Lifetime protection for less than 1/4 cent per T-Line dollar invested ...with FANNER Superformed* ARMOR RODS

at these vulnerable points

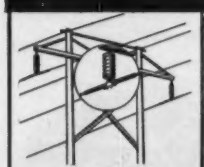




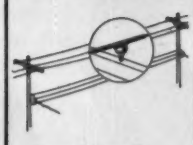
For only a fraction of a penny per transmission-line dollar invested . . . Fanner SUPERFORMED armor rods give lifetime protection to conductors at vulnerable supporting points.

Top-quality products of the world's FIRST MAKER of machine-formed armor rods . . . Superforms are uniformly strong, dimensionally accurate, smooth surfaced, easy to install. Available for all conductor types and sizes. Learn how little so much extra protection costs. Call today.

A FEW FANNER Superforms AND FINEST PLASTIC PRODUCTS

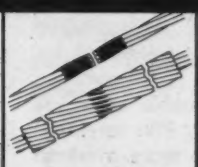


ARMOR RODS . . . Protect long spans at supports



LINEGUARDS . . . Protect short spans at supports

FANNGRIPS . . . For dead-ending strands or conductors



FANNSPLICES . . . For joining or patching strands

Plastic TREEGUARDS . . . Protect conductor surface covering

Plastic KOVER-GUARDS . . . Protect surface-mounted conductors

*A superior forming method in accordance with Patents No. 2,769,478 and 2,588,663—other patents applied for.

THE FANNER MANUFACTURING COMPANY
Brookside Park • Cleveland 9, Ohio

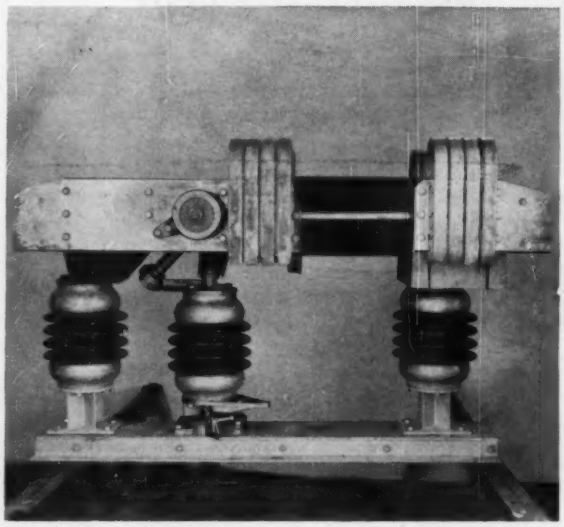
DIVISION OF TEXTRON, INC.

Fine Fanner Superformed Products

A-4348A

New Equipment

Air-Break Disconnect Switch...



. . . uses bus-bar copper throughout, G-45, 3 PST, 15 through 69 kv, in 2,000, 3,000, 4,000 or 5,000 amp, is suitable for generator-bus disconnect. The copper bus-bar feature is said to provide a practical solution to the occasional outrigging problem, because longer side members are employed. The G-45, 23-kv, 5,000-amp switch (right) is provided with a full set of spare blade-contact surfaces. These spare surfaces do not need to be bolted in, or even near, transfer surfaces. Such spare surfaces are available for switches which may be operated excessively. There are high-pressure, line-type contacts, silver-to-silver, in the hinge as well as in the jaw of the unit, and all bolted surfaces are silvered also. A great variety of terminal-pad arrangements can be furnished for direct attachment to station bus—regardless of whether the bus is made of square or round pipe or of multiple-bar design.

USCO Power Equipment Corp, Birmingham 1, Ala.

Traveling Wave Tubes . . .

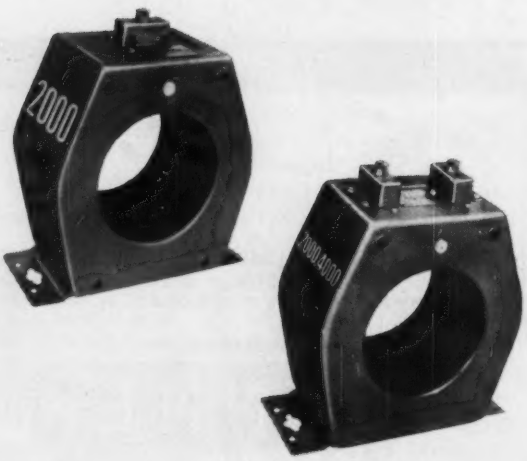
. . . can be mounted in close proximity to one another because of low external magnetic fields. The QKW928 tube, to amplify power on repeater station systems' microwave relay links, has compact construction—achieved through periodic, permanent magnet focusing. Tube has 5,925 to 7,125 Mc frequency range with waveguide output; minimum power (saturated) is 12 w; small signal gain is 36 db. Distortion is said to be low and tube's all metal-ceramic construction extremely rugged.

Raytheon Co, Foundry Ave, Waltham 54, Mass.

Current Transformer . . .

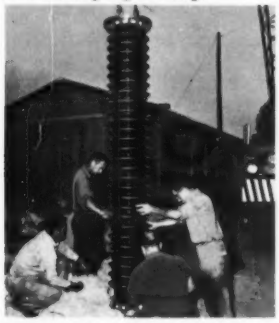
. . . features mounting versatility, with its four corner holes making it possible for units to be flush-mounted to a flat surface for either a vertical bus coming up through a platform or a horizontal bus extending through a wall or panel. Type EMC, designed for high-current metering and relaying on low-voltage systems, is available in single or double ratios. It is a 600-v class, window-type unit, 800 to 4,000 amp, with reportedly 33⅓ to 100% more overload capacity. The dual-ratio units are offered in arrangements of either three or four terminals. In the four-terminal design, one set of terminals is located at one end at the top of the transformer; the second set is on the other end, with this arrangement said to allow for more positive terminal identification. Each set has a separate name plate. The 5½-in.-dia primary opening can accept a 4-sq-in. bus or multiple cables.

Westinghouse Electric Corp, Pittsburgh 30, Pa.



BASE PLATE gets lift into place with all essential fittings in position.

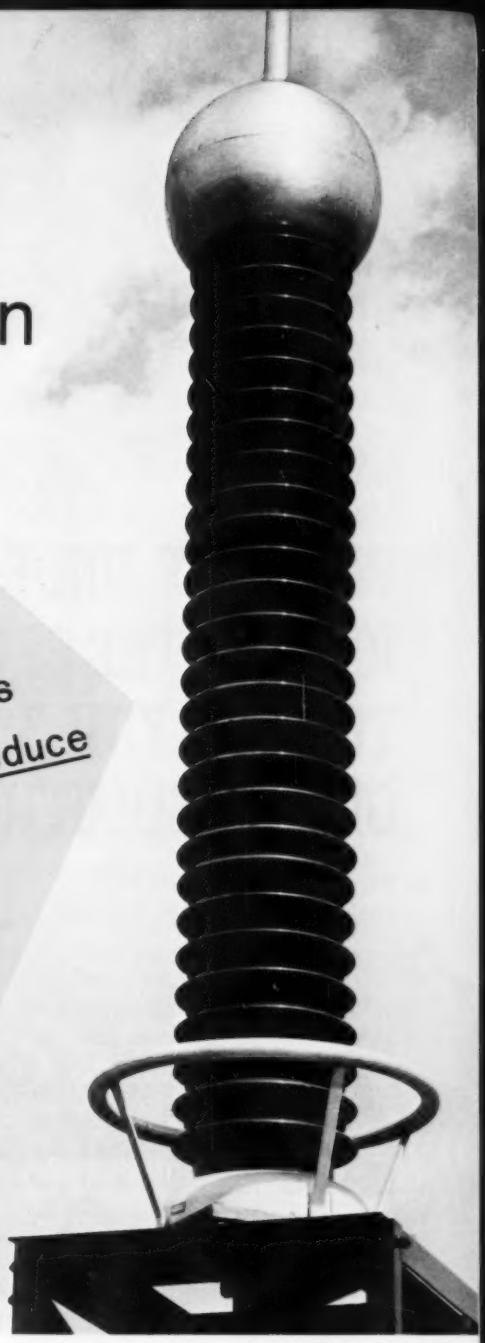
STRESS CONE installation is simply a matter of tightening the build-up on the cable. Square-cut ends permit inspection during tightening.



GRADING CAPACITORS are already installed in this porcelain housing — connected and sealed at the factory.

Saves Installation Time

Factory-assembled pothead components speed field work, reduce exposure time



To save you time and money, O-B pre-assembles under careful factory procedures many components of its capacitor-graded pothead.

Because O-B forms the stress cone right in the lower build-up roll, field installation is simply a matter of tightening the build-up on the cable. Square-cut edges of the roll make inspection during installation easy. The square-cut ends of the roll prove that the stress cone is the same shape as produced on factory machines.

Grading capacitors need never be touched in the field - - they're installed in the porcelain housing at the factory so that when you lower the porcelain into place, the capacitors are ready for service.

All these time-saving, factory-assembled components reduce the exposure time of the cable insulation by hours - - a very important consideration.

If you are planning cable systems and want potheads that are simple to install and are factory-precise, choose O-B.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10115-H

OHIO BRASS MANAGEMENT REPORT

WE MUST UNDERSTAND 100% OF THE PROBLEM TO GIVE YOU 3% OF THE SOLUTION

BY GEORGE L. DRAFFAN
CHAIRMAN, OHIO BRASS COMPANY

Utility engineers often ask Ohio Brass for advice in designing a transmission line—advice on items other than the insulators and supporting hardware that we supply. Besides being flattered, our engineers often are in a position to provide competent advice. But they make it plain that it is just advice. The authorities on towers are the people who make towers . . . the same for conductors.

THIS DOES NOT DENY OUR STRONG INTEREST in tower design and conductor characteristics or even the greater transmission line problems such as cost of right-of-way and continuity of service. Although Ohio Brass products constitute about 3 per cent of the cost of a transmission line, we must have complete understanding of the components that make up the other 97 per cent.

WHY IS THIS ATTITUDE IMPORTANT TO YOUR COMPANY? I can think of several reasons. If we regard a suspension insulator as a seemingly simple combination of porcelain and metal, we would proceed to make it according to normal quality control standards which might tolerate one failure in a hundred. But when we recognize every one of these insulators as a vital part of a multi-million-dollar line on which thousands of customers depend for electric service, then this simple, inexpensive item becomes quite another

100 3

matter. We can justify 100 per cent mechanical and electrical testing of every insulator.

NOT ONLY MUST THERE BE FASTIDIOUS CONCERN for each insulator but also considerable attention must be paid to the attachment points and how tower and conductor design will affect electrical performance of the insulator. For a generation or more, it's been normal procedure for O-B's high voltage laboratory to spend much of its research time working with tower and conductor designers. A specific result of this research has been the development of arrangements for bundled conductor now going into service on many extra-high voltage lines.

YET ANOTHER DIVIDEND OF THE BROAD APPRECIATION of transmission problems is specific product improvements that result. We wouldn't develop new instrumentation for studying the minute deflections of an insulator porcelain if we didn't appreciate the need for increasing insulator strength as conductor sizes increase and voltages go higher. Or develop corrosion protection if we didn't realize that increased industrial loads and air-borne contamination will accelerate corrosion forces.

AS A RESULT OF THIS BROAD UNDERSTANDING of transmission problems, our design engineers approach their work with sureness and confidence. The payoff for your company is a product that performs in the best interest of the entire transmission line.

HOLAN

10180-H

OHIO BRASS COMPANY, MANSFIELD, OHIO

Porcelain Insulators – Line Hardware – Capacitors – Lightning Arresters Bushings – Holan Truck-Mounted Power Devices and Bodies – Bronze Valves

Electrical World

JULY 24, 1961

Management Newsletter

COAL

OIL

NATURAL GAS

HYDRO

NUCLEAR

The Future of Fuels—Part III

WHAT WILL FUELS COST?

Future fuel prices dictate the type and location of new generation. Whether the unit is to be nuclear or fossil-fuel, and whether it is to be located at the mine-mouth or at the load depends on future mining and transportation prices. In this third article on fuels, *Electrical World* presents the thinking of those who supply and transport fuels as well as of the fuel users—the electric utilities.

WHAT DO UTILITIES EXPECT?

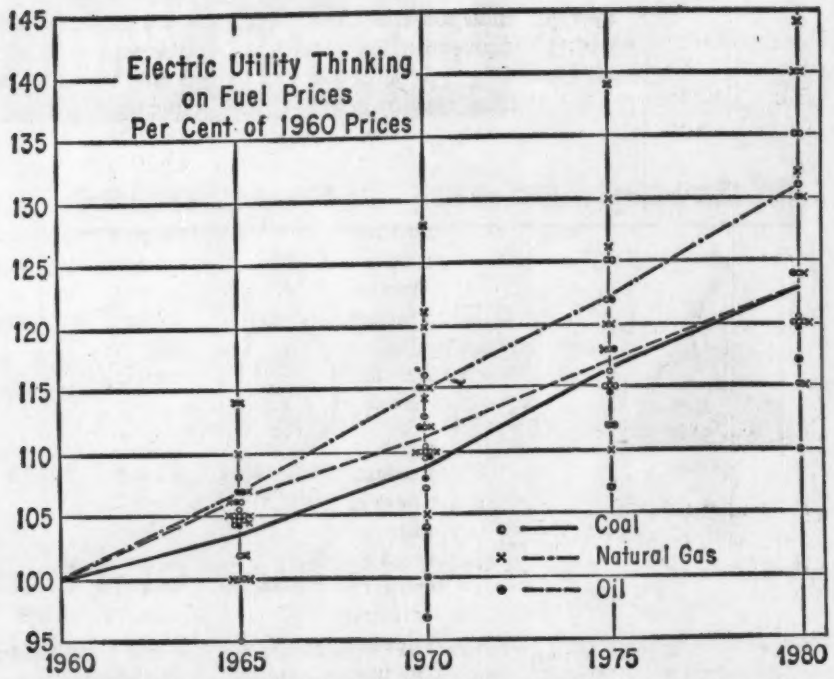
Electric utilities anticipate higher fossil-fuel and lower nuclear-fuel prices. More specifically, they expect coal prices to rise the same amount that nuclear prices drop—about 10% in ten years. Oil will rise slightly more than coal, and natural gas will go up much more than oil. As fossil-fuel prices go up and nuclear prices come down, utilities will switch to nuclear fuel for their power plants more and more. Similarly, as natural gas prices rise above coal, more utilities will change to burning coal for their plants.

These conclusions are based on two surveys. One, a recent *Electrical World* survey on fossil-fuel prices, is charted on the next page and clearly shows that most utilities anticipate rising prices. However, some utilities will vary from the average considerably. For instance, one utility expects coal to cost 3% less in 1970 because of a change in hauling coal. Another survey, made over six months ago by Titus LeClair of General Dynamics Corp, shows that in ten years nuclear prices will go down 9.4% while fossil-fuel prices go up about 12%. This survey was conducted before the recent decrease in nuclear fuel prices by the Atomic Energy Commission. While electric utilities expect a healthy rise in coal prices, this is by no means the universal feeling of the coal industry.

WHAT DOES COAL THINK?

Prices will go up but much less than utilities expect, claims the coal industry. Coal feels that the past ten years has shown what it can do in the way of mechanization and holding down costs. Coal seems to be talking prices which rise about one-half as much as utilities expect. One coal company says that 1965 prices will be the same as today's and that 1975 prices will be only 10% higher. Another coal company feels that today's prices should be 10% higher but that they would then remain level through 1980. Finally, a third company says that coal prices from now to 1980 will be the same, in terms of today's dollars.

Why are coal companies more optimistic on holding down prices than utilities. They feel they've learned something in the past ten years, how to mechanize and hold down costs. And they know they can go much further on the road to



FUTURE FUEL PRICES vary widely, but natural gas is usually much higher than oil, and oil is slightly higher than coal, according to 15 electric utilities surveyed recently

mechanization. Ray Salvati of Island Creek Coal Co says that "I cannot agree that today's level of prices, especially in the southern high volatile areas, can be used as a basis for predicting the future, but I am sure that even with needed improvement, coal will have a more stabilized price level than any other form of fuel." Similarly, S. L. Jewett of Peabody Coal Co says that "huge investments in modern equipment, modern methods, and continued research can be relied upon to hold down fuel prices for the utilities and the general public."

Clearly there is a difference in thinking on future coal prices. Utilities expect higher prices than the coal producers admit. And it seems that a bit of this same difference exists between utilities and the gas-oil industries.

NATURAL GAS TO PLATEAU

The price rise of the past ten years was abnormally steep but it will soon level off, according to the gas industry. The gas industry compares the steep rise for the past ten years to that of coal in the 40's, and the plateau, which will come soon, to that of coal in the past ten years. In a way, they're saying that prices are paralleling coal prices but lagging them by ten years.

Oil, however, feels that there will be a small price rise, even under a free economy. B. R. Dorsey of Gulf Oil Co says that it is impossible to predict the future price of oil under a system which controls imports but that a small price rise would occur under a free economy. However, it is clear that a small price rise with unrestricted imports means a larger price rise if imports are restricted.

Utilities expect higher prices for fossil fuels; so do the supplier industries. Differences exist mainly in the amount of the rise in prices. Generally the supplier industries are much more optimistic of maintaining their prices than the utility industry expects. And so are the transportation industries where rails differ considerably from utility thinking.

RAIL RATES WILL HOLD

Rails feel that coal-hauling rates will hold steady or even go down. Increasing competition from trucks, coal pipelines, and EHV is forcing rates to remain at the present level. In addition, the rails hope that the larger tonnage of coal going from mine to power plant will promote shuttle-service trains. Delivery of coal to one point lends itself to trainload shipments, and as the amount of this coal goes up, rails can make cost economies and hold down rates.

One railroad predicts that rates will go down even in the face of increased costs for materials, if special shipping arrangements can be made with the utility companies. Another railroad said that "our experience has been that we have been unable to increase our coal rates to the same extent as cost increases have been forced on us, and this will probably continue in the future." Finally, a third railroad feels that freight rates for carrying coal to electric utility plants will remain relatively stable in future years.

Rail rate reductions on coal trace back to the middle 1950's when rails began to reduce rates on tonnage which faced displacement by competitive fuels or could be shipped by alternate means of transportation. Prior to 1950, the carriers generally charged a flat rate to move a ton of coal, regardless of the competition or size of shipment. In fact, many of these rates were based on what the traffic would bear rather than on costs of competition. They have since introduced volume, trainload, and tidewater rates to hold markets they already have and to establish new ones. They have consented to competitive rates where markets were threatened by other fuels. But one of their stiffest competitors is that new use of pipes to carry coal.

PIPELINES LOWER HAULING COSTS

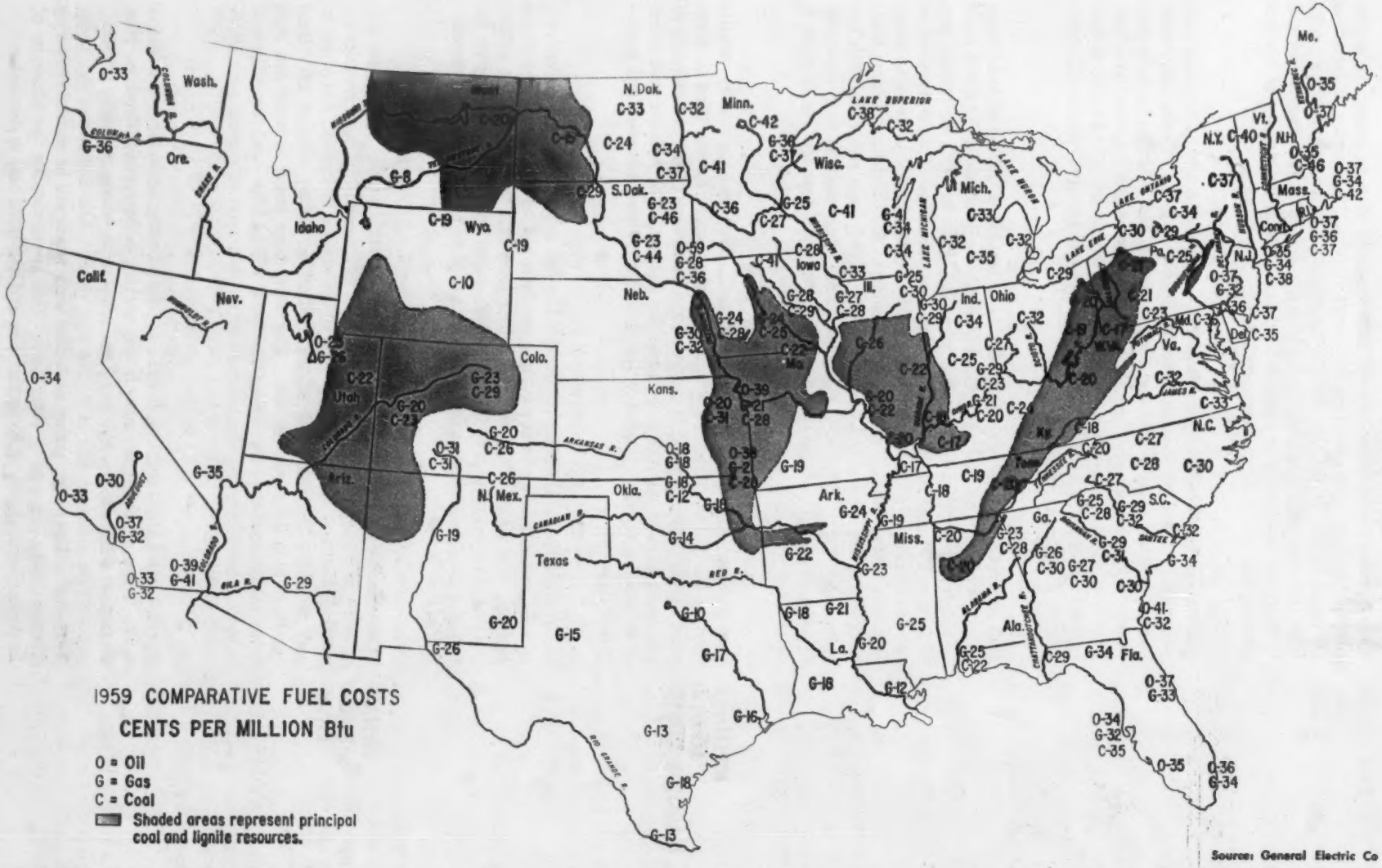
Coal pipelines will reduce transportation costs. They may do this by actually carrying the coal or by posing a threat to rails, thereby forcing them to lower rates. Each time a pipeline is proposed, the utility can expect the railroads to talk lower rates to forestall or postpone the pipeline. The rails are well aware of the pipeline threat and intend to fight it with all means—economic and legal—at their disposal.

Many pipelines are still being discussed. The line to Michigan will deliver coal at 50¢ a ton less than present rail rates, but these will be lowered to forestall the pipeline. The line to California will deliver Utah coal for 35 to 40¢ a million Btu, definitely in line with 1959 fuel costs, as shown on the fuel cost map on the following page. But just as important and useful as pipelines is the transportation of fuel by wire.

WHAT ABOUT EHV?

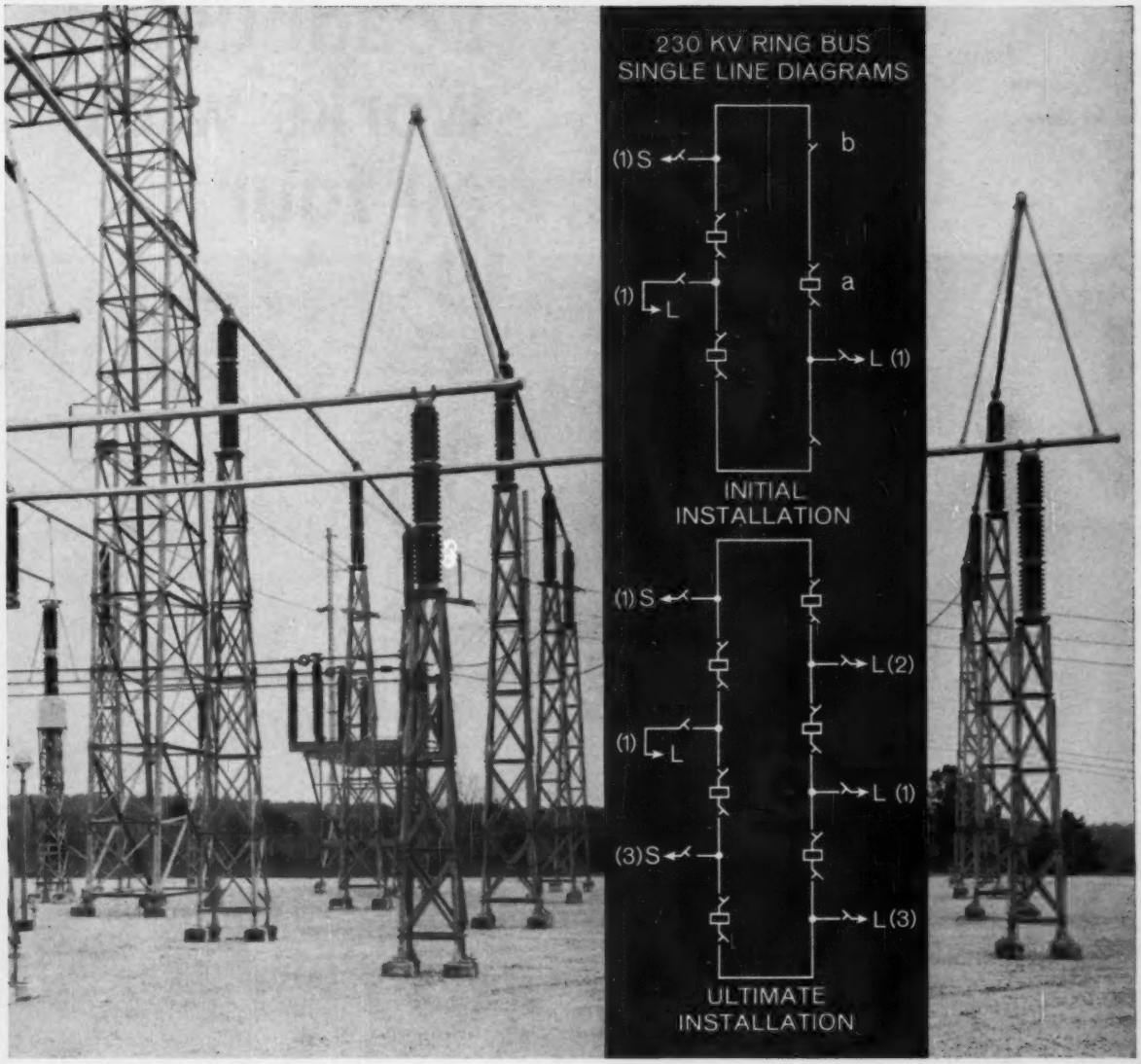
Extra-high-voltage transmission notifies rails that unreasonable freight rates can drive an increasing number of stations to the mine mouth. It also provides an inflation-proof way of transporting some of the utility's fuel needs, and it fits in with the utility desire for stronger interconnections. Many miles of EHV lines will be built in the coming decade. They carry more power at lower cost than lower voltage lines—about one-third the cost of 132-kv lines—and they will result in more mine-mouth plants unless rails adjust their rates to prevent such mine-mouth plants.

Where will fuel prices go? Up, to be sure. But probably not as far as the utilities think. There are simply too many factors working in the opposite direction. New mining and drilling technology and fierce competition among railroads, pipelines, and EHV transmission will battle the cost spiral. And dominating the whole picture is the descending ceiling of nuclear costs which will be putting increasing pressure on the prices of all other fuels. This means that for the remainder of the century, utilities will probably find their fuel bills quite easy to live with.



Source: General Electric Co

COSTS FOR FOSSIL FUELS consumed by steam-electric generating plants in 1959 show high and low-cost fuel areas in US. Where plants are close together, the cost figures represent average fuel costs for the area. Principal coal fields and major waterways are also shown in order to indicate the lower-cost coal areas



Spend less now... expand later *without interrupting service*

How? By designing Alcoa® aluminum rigid ring bus into your next switching station.

Like this one—the Goat Rock Substation—engineered by Georgia Power Company of Atlanta. As a key station in the utility's system, this substation was given unusually thorough engineering review. Nothing less than the best in design and material could be considered.

Even a quick look at the diagram will show how easy it is to add source or load lines without interrupting service. In the initial installation, one source line energizes a ring bus from which two loads are supplied. To add a third load (2), open the breaker "a" and switch "b". In this way the additional breaker and isolating switch can be installed without any high-voltage hazard to construction personnel.

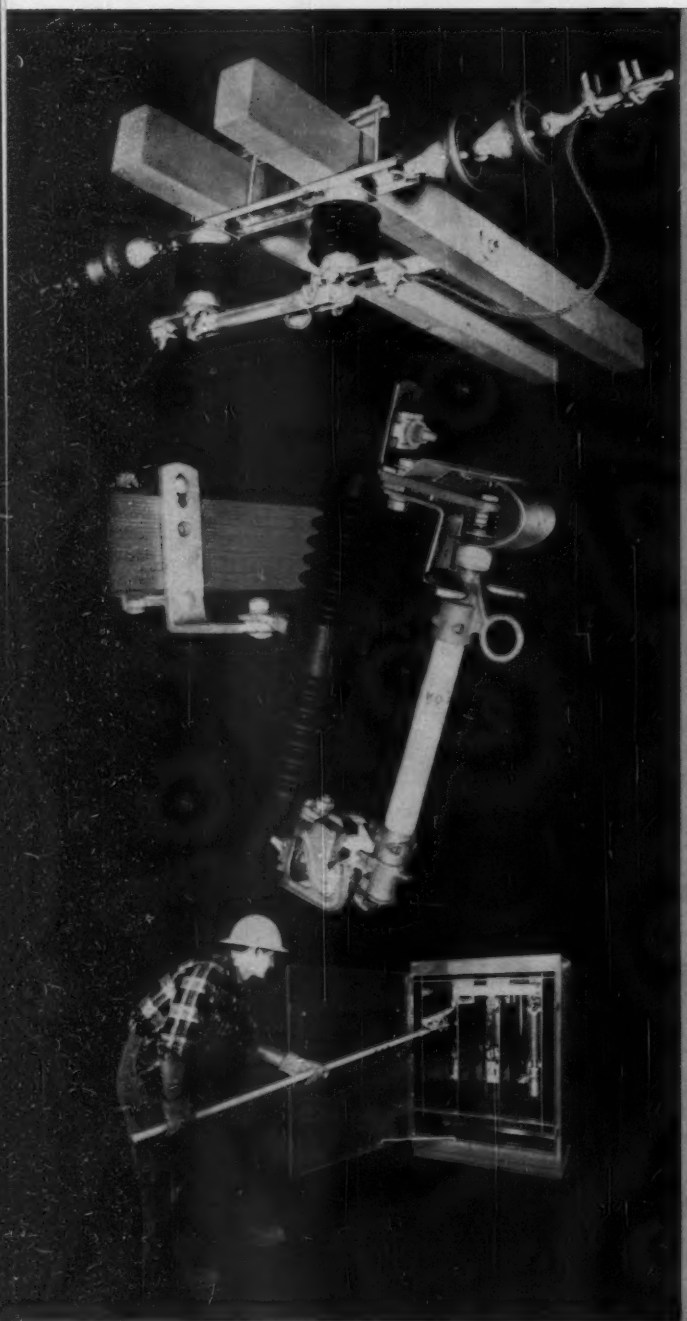
Further expansion involves adding a new source line and a fourth load line (3). This will be accomplished in the same manner as adding load line (2). Naturally, bays must be constructed for installing lines at (3).

That's the story: Reliability, expansion without interrupting service, lower initial cost. All accomplished with Alcoa aluminum rigid bus.

More facts? See your usual source of Alcoa materials. Or write to Rome Cable Division of Alcoa, Dept. 1-71, Rome, New York.

ALCOA
ROME CABLE
DIVISION

Loadbuster works with all four



Portable loadbreak tool is usable with cutouts, disconnects, power fuses, and pad mounted gear

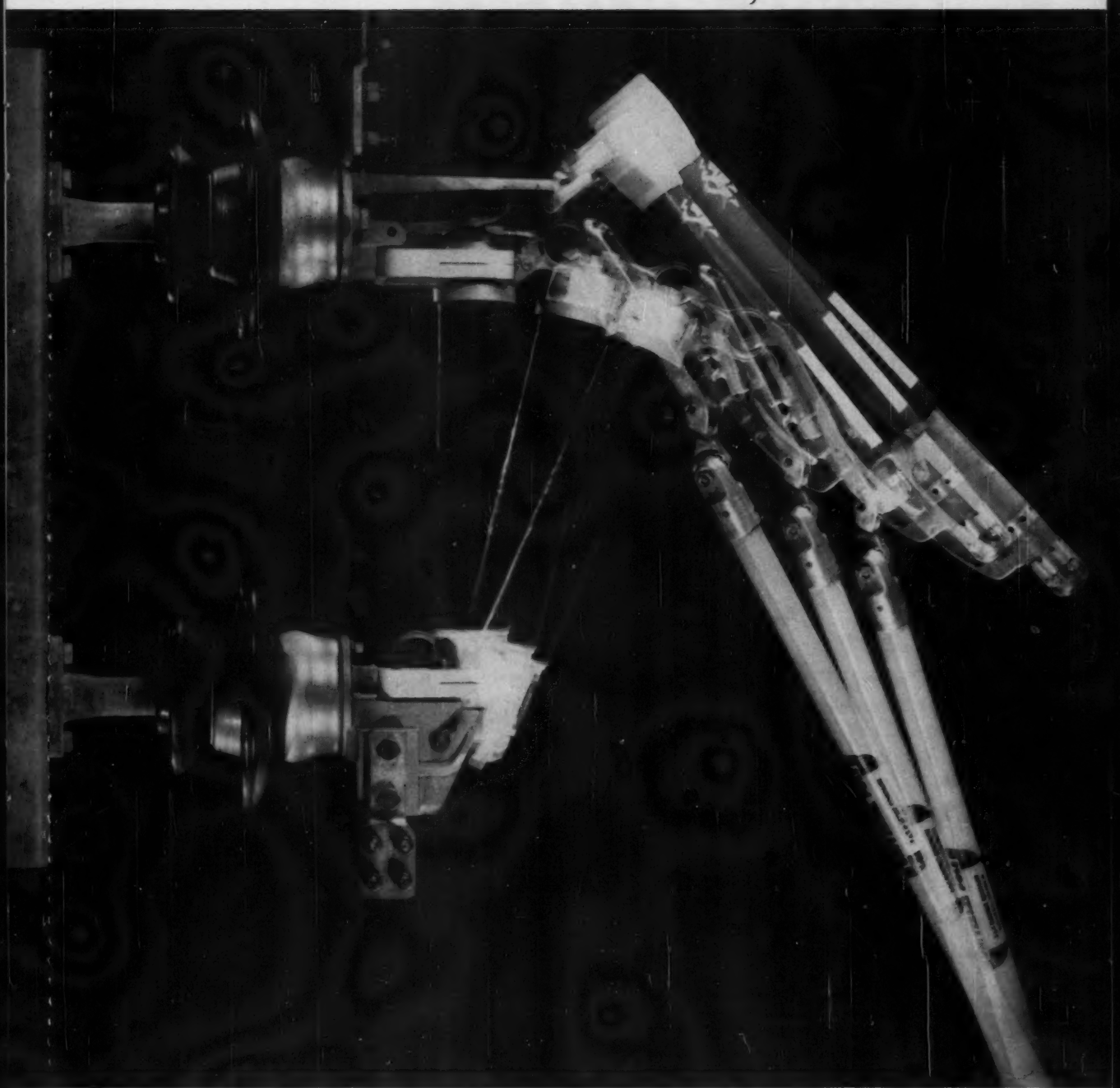
Loadbuster, S&C's portable loadbreak tool, earns its own way by providing truly unlimited load switching when and where it's needed. With its load switching range through 400 amperes at any system voltage through 14.4 kv, Loadbuster works with cutouts, disconnects, power fuses, and pad mounted gear.

Within its voltage range, Loadbuster can interrupt full loads through 400 amperes, all associated magnetizing and line charging currents, and can switch all typical capacitor banks. Thus, this easy-to-carry switching device:

- Replaces link break cutouts
- Provides full load switching for cutouts and power fuses
- Replaces group operated disconnects with stick operated disconnects at sectionalizing points
- Provides full load switching for hook-stick disconnects
- Replaces load interrupter switches where group operation is unnecessary
- Brings overhead switching practices to residential underground

Loadbuster's portability, versatility, and long operating life (it's designed for daily field usage) have made it standard equipment on many utility service trucks. Ask your S&C representative for a demonstration of how Loadbuster can cut your operating costs.

S&C ELECTRIC COMPANY
4421 Ravenswood Avenue • Chicago 40, Illinois
Specialists in High Voltage Circuit Interruption since 1911



You simply hook Loadbuster across the upper contact of a disconnect or fuse and open it in the normal way. There is no arc, link breakage, contact burning, or danger to the operator. Just disengage the device and it's ready for instant use again.

NOW you can have BOTH!
THIS SPACE REPRESENTS AREA OCCUPIED BY A WOOD INSULATOR WITH ARCING HORNS
COMPARE WITH
UNPARALLELED electrical characteristics
MINIMUM occupied SPACE
...if you install
HUBBARD Fiber Glass Strain Insulators

TOP CONSIDERATIONS in rating Strain Insulators dictate the choice of HUBBARD because . . .

ONE: "Unparalleled Electrical Characteristics" which mean permanently maintained, high insulation values resulting from the use of materials impervious to moisture or decay.

TWO: "Minimum Occupied Space" because *NO ARCING HORNS* are necessary. This means shorter guys, less interference with other structural components and LOWER INSTALLED COST.

BETTER PRODUCTS *through Creative Engineering*

HUBBARD AND COMPANY
CHICAGO 50, ILLINOIS

Four Corners Rises

(*Continued from page* 33)

the main bus when the transfer bus is required for lines. Bus sectionalizing breakers are planned for the terminal stations as they expand. Due to the necessity for installing 345-kv series capacitors in the future in the Cholla bus, all lines to the south will be on one end of the bus, those to the north on the opposite end. This arrangement will limit the benefit from bus sectionalizing breakers.

Buses will be strain type, utilizing single all-aluminum conductor with compression fittings. Where tubular bus is required, the aluminum will have welded fittings. The buses are designed for 10,000-Mva fault capacity. 345-kv buses will have 1,300 and the 230-kv buses a 900-kv BIL.

At the initial Four Corners switchyard, major equipment will include two 3-phase, 430-Mva (FOA) 345-230-kv autotransformers; one 3-phase, 30/40/50-Mva (OA, FA, FOA) 230-69-kv autotransformer; two 3-phase 65-Mvar, 230-kv, air-core, oil-immersed shunt reactors; two 3-phase banks of 50-Mvar, 14.4-kv air-core shunt reactors; one 3-phase, 300-Mw, 230-kv resistor bank, five 230-kv, 10,000-Mva circuit breakers, and associated equipment.

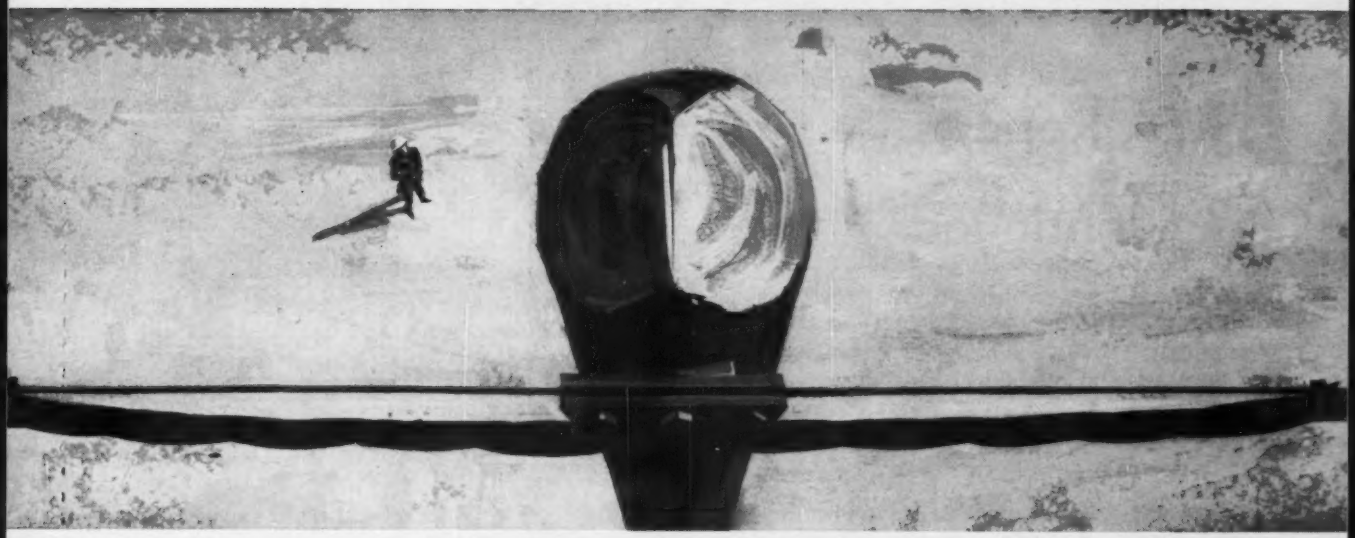
Equipment at Cholla

At the initial Cholla switchyard the major equipment will include one 3-phase, 84/112/140-Mva (OA/FA/FA) autotransformer; one 3-phase, 25-Mvar, 230 kv, air-core, oil-immersed shunt reactor; four 345 kv-circuit breakers; four 230-kv, 10,000-Mva circuit breakers, and associated equipment.

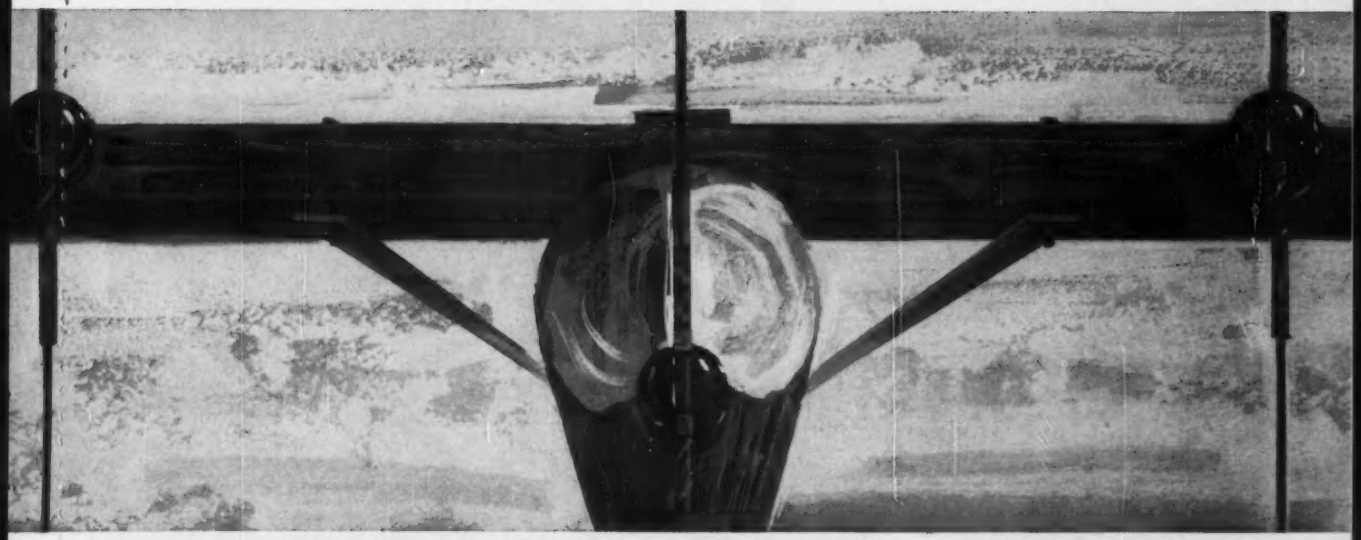
The initial Pinnacle Peak Substation will include one 3-phase 370-Mva (FOA) 345-230-kv autotransformer; two 3-phase banks to 35-Mvar, 14.4-kv air core reactors; two 3-phase, 30-Mvar banks of shunt capacitors, seven 230-kv, 10,000-Mva circuit breakers, and associated equipment.

The Pinnacle Peak Substation will be tied into the Phoenix area load net by a system of 230-kv lines and bulk substations, major portion of the load being distributed at or near the Phoenix-area generating stations.

Hang it this way—



instead of this way—



and cut costs with Anaconda Self-Supporting Aerial Cable

Anaconda self-supporting aerial cable takes up less room wherever it's used. No crossarms needed—because it's attached directly to the pole. That means right of way charges go way down. It also means you can cut tree-trimming expenses by more than a half. The savings on tree-trimming alone may more than justify the cost of aerial cable.

Close configuration of the cable gives better voltage regulation because of balanced low reactance. There are fewer complaints about TV interference, because conductors are insulated and lashed together. The whole installation has a neater appearance because of unit assembly, even for three-phase circuits.

For complete information about Anaconda self-supporting aerial cable, contact Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York. Department, EFL-1-EW.

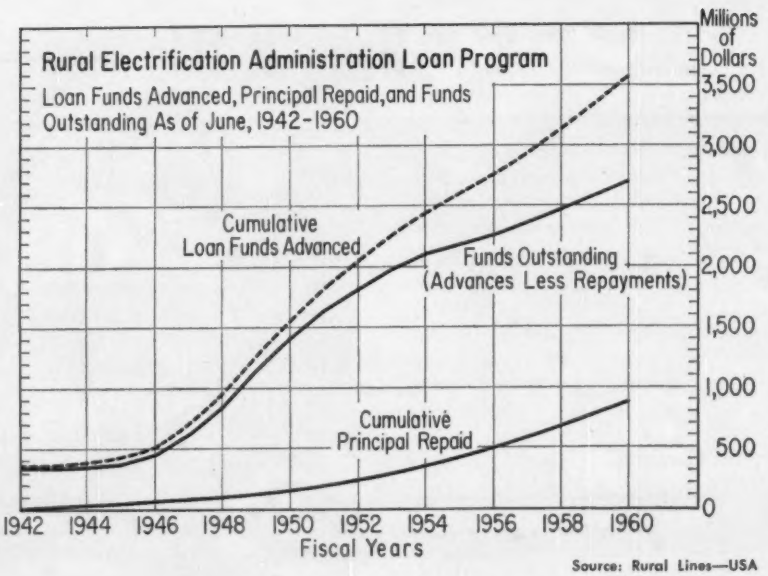
61262

ASK THE MAN FROM

ANACONDA®

FOR SELF-SUPPORTING AERIAL CABLE

REA Reports Continued Co-op Growth In 1960



Source: Rural Lines—USA

Fiscal 1960 witnessed the continued growth of electric co-ops under the Rural Electrification Administration.

Borrowing electric systems of the REA bought more power, and at lower rates, during the year ended June 30, 1960, than during any previous year, REA reports.

The year saw no significant shift in supply patterns: Borrowers bought 39.3% of their requirements from federal agencies (up 0.1% over the previous year), 37.8% from power companies and industrial suppliers (up 0.4%), 7.3% from other public systems (up 0.1%), and generated 15.6% (down 0.6%).

Total energy input for borrower systems was 29,266,105,000 kwhr. Although co-op generation dropped in percentage, its total was up 300 million kwhr over 1959.

The Tennessee Valley Authority continued to supply about half the power sold to REA borrowers by federal agencies. TVA's sales climbed by about 724 million kwhr to a record 5,548,532,900 kwhr.

Georgia Power Co remained the largest supplier among power companies. It also edged out Southeastern Power Administration in sales. Georgia Power's total was 859,550,100 kwhr, up by 126 million kwhr over the previous year. SPA's total was 824,624,000 kwhr.

Power purchased from power companies and industrial suppliers cost an average of 8.45 mills per kwhr, while federally purchased power cost an average of 4.8 mills and power from other public systems cost 8.5 mills. Power generated by co-ops averaged 1.09¢ per kwhr.

REA loans continued to outstrip principal repayments. Funds outstanding rose to $2.7 billion. Co-op investment in 2% REA series Treasury Bonds reached $18,763,000 purchased by 281 systems.

Public Power Groups File for New Reactor

Three public power groups are filing proposals requested by the Atomic Energy Commission to participate in a 50-Mw organic-moderated power reactor project. The proposals must be at AEC by July 24.

Grand River Dam Authority, Vinita, Okla.; Burlington Light Department, Burlington, Vt.; and Plains Electric Generation & Transmission Cooperative, Albuquerque, N. M., are the utilities. They were asked by AEC to submit formal proposals for the cooperative nuclear power project after the Commission received and evaluated, initial expressions of interest from several other publicly-owned electric utilities.

Expressions of interest in the organic reactor was the first of two steps in the solicitation of proposals by AEC. The Commission first evaluated specified information on all interested utilities' proposed sites and ability to operate the nuclear central station power plant under terms specified by the government.

Then AEC asked three of the utilities to submit formal proposals. Cooperatively and publicly-owned utilities which also filed expressions of interest were: City of Greenville, Texas; City of Hamilton, Ohio; Choptank Electric Cooperative, Denton, Md.; Dairyland Power Cooperative, La Crosse, Wis.; Delta Electric Power Assn, Greenwood, Miss., together with Southwest Mississippi Electric Power Assn, Lorman, Miss.

The utility which AEC finally selects to operate the organic reactor will also be expected to contribute a suitable reactor site and the conventional generating equipment.

The utility will run the plant for a minimum of five years as an integrated part of its generating and distribution system and purchase the reactor's steam.

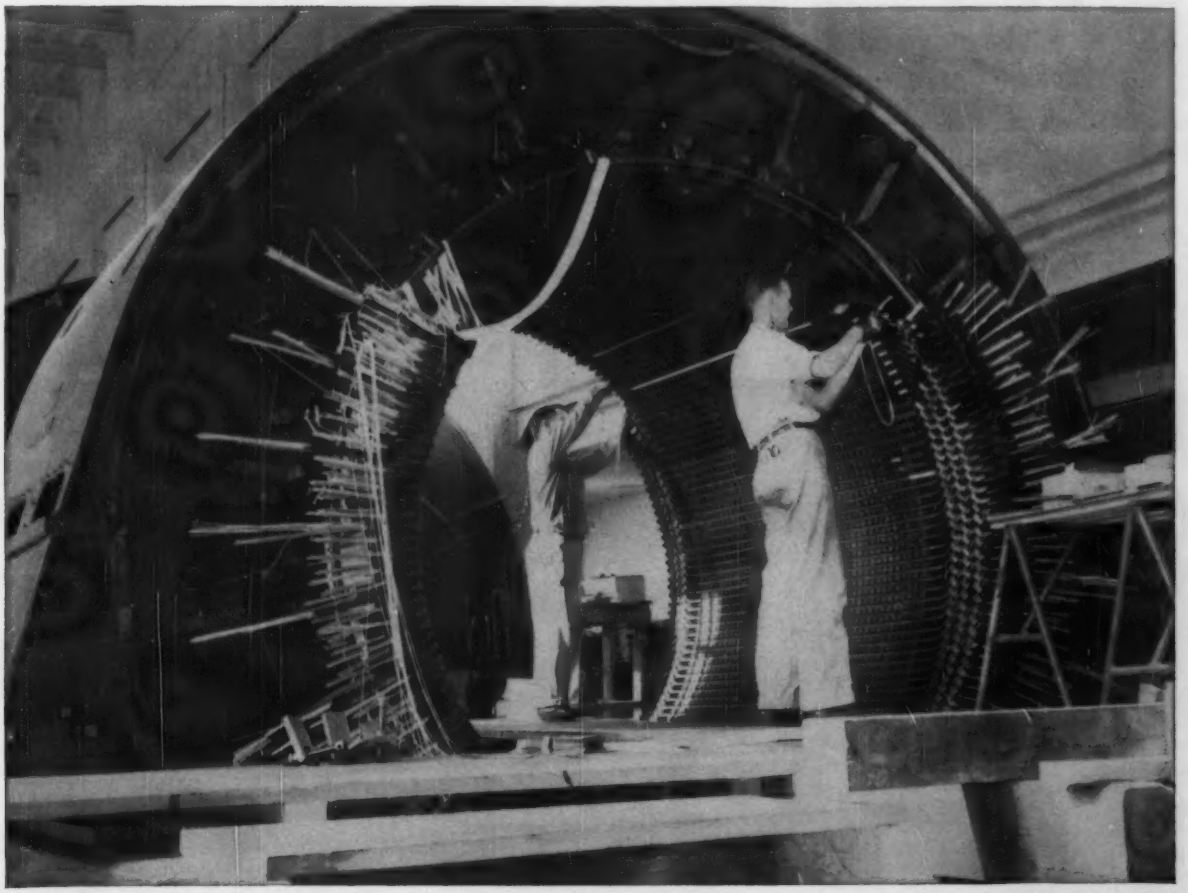
Conceptual design of the reactor is now under way by Atomics International Division of North American Aviation. AEC expects to start construction by January, 1962.

Stator capacity increased by rewinding with NECCOBOND coils by National... *the specialists in electric coils/repair service*

Stator capacity of this 37,500 KVA Synchronous Condenser was increased at no change in temperature rise when the machine was rewound with new NECCOBOND coils having more efficient copper-slot ratio. Complete service included coil design and manufacture, installation and test. In addition, revolving field coils were completely rebuilt, installed and tested.

Whenever *you* need service on rotating electric machinery—whether large or small, whether you need a few coils or a complete rebuilding job—contact National Electric Coil. Our service is fast, thorough and dependable.

For information call National's Columbus Plant, HUdson 8-1151 or check the nearest National Field engineer.



NATIONAL COILS

National Electric Coil

COLUMBUS 16, OHIO • IN CANADA: ST. JOHNS, QUEBEC

DIVISION OF McGRAW EDISON

News About People

Chairman, President Chosen

BROWN FELBER

Theron A. Brown has been promoted to chairman of Madison (Wis.) Gas & Electric Co. Edward R. Felber succeeded Brown as president and general manager.

Brown has been president, general manager and a director since 1958. He started with the utility, working on a part-time basis, while still in college.

Felber, who joined Madison G&E in 1922 as a cadet engineer, was executive vice president prior to his recent promotion. He was elected to that post in 1950, and has been a director since 1929.

BAUER HOOVER

Two VPs Appointed at Pacific P&L

Albert Bauer and Veryl N. Hoover have been named vice presidents of Pacific Power & Light Co, effective with the recent merger of California Oregon Power Co into Pacific P&L.

Bauer, general manager of system operations, has been with Pacific P&L since 1955, when he joined as assistant chief engineer.

Hoover, manager of the Wyoming division, was an executive with Mountain States Power Co when it was merged with Pacific P&L seven years ago.

Protect the MAIN LINE with

G&W Fused Distribution Centers are an example of the full line of G&W equipment that protects shopping centers all across the country.

McGraw-Edison Boosts Kerr, Plank

KERR PLANK

W. E. Kerr has become chairman of McGraw-Edison Co's Pennsylvania-Lectro Management Group, which includes the following divisions: J. G. Dickson; Lectromelt Furnace; Pennsylvania Transformer, and Pittsburgh Lectrodryer. Fred H. Plank succeeded Kerr as president of Pennsylvania Transformer.

Also at Pennsylvania Transformer, W. R. Swoish, vice president and sales manager since 1949, was named vice president of marketing, and Walter W. Renberg became sales manager.

Parker to Head Marketing In A-C New Products Unit

PARKER

Charles W. Parker Jr has been promoted to general marketing manager of Allis-Chalmers Manufacturing Co's new products department. Also, the recently organized department was renamed from special products to new products.

PERSONAL BRIEFS

Philadelphia Electric Co has appointed **Edward S. Halfmann** assistant research director in the engineering and research department. **William J. Johnson** succeeded Halfmann as engineer in charge of the electrical research section.

Edward Thornton has been elected to succeed **Mortimer W. Newton** as president of the New England Conference of Public Utilities Commissioners. **George A. McLaughlin** was named secretary-treasurer.

Godwin Williams Jr has been promoted to assistant director of Tennessee Valley Authority's power system operations division in Chattanooga.

Arkansas Power & Light Co has made **Paul J. Griffith** assistant vice-president and promoted **Bruce M. Menees** to Little Rock division manager.

New assistant treasurer at Monon-

(*Continued on page* 66)

G&W Fused Distribution Centers

*** Ever had trouble with a branch 4-kv primary tap that blew the whole main feed?**

*** Did you ever want to work on a tap and find you had to shut down the whole system before the tap could be isolated and safe to handle?**

G&W Fused Primary Distribution Centers solve these problems completely by providing a fused, three-phase or single-phase disconnecting device that can be operated under load for any tap off the main primary supply. Ideal for protecting primary loops or radial systems operating at voltages up to 15 kv, the G&W Centers can be used indoors or outdoors; are easy to install; and provide a disconnect for safety.

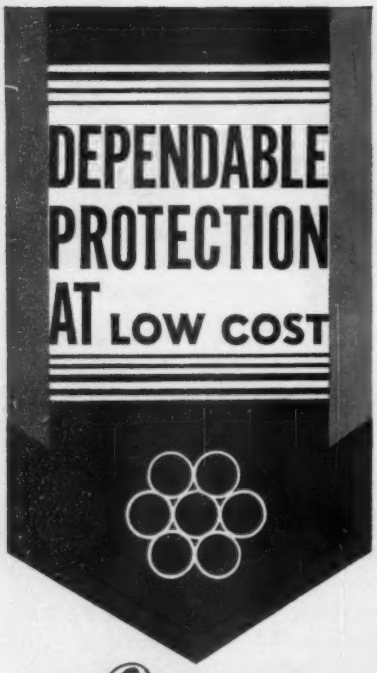
G&W Fused Distribution Centers have proved themselves time and again in applications at shopping plazas, industrial plants, and institutions with one or more buildings but these are only a few of the many places where they can be effective.

Distribution Centers are flexible. One or more circuits can be brought into a center to supply a fused load, or a single supply circuit can be used to feed a fused bus from which multiple load circuits are taken. The main primary feed can terminate in the box or run through as required. Insulated bus pads are provided for each phase leg with no limitation on the number of taps. The box can be bolted onto a concrete pad or embedded four to six inches into the concrete when the pad is poured.

Distribution Centers are gasketed to provide a weatherproof unit that fully meets NEMA Type 3 standards for weatherproof construction. Watertight, submersible construction is also available.

G&W ELECTRIC SPECIALTY COMPANY
3500 WEST 127TH STREET • BLUE ISLAND, ILLINOIS
Canadian Mfr. • Powerlite Devices, Ltd. • Toronto, Montreal & Vancouver
superior quality standards — inspired specialized design

C61-2



Crapo

GALVANIZED STEEL STRAND

The strong, tough individual wires which make up **Crapo** Galvanized Steel Strand are protected against corrosion by a uniform, tightly-bonded, ductile coating of commercially pure zinc. This heavy, dense coating of zinc, applied by one of the time-proven **Crapo** methods, not only seals out rust but further protects the base metal by sacrificing itself through galvanic action. The result: long and dependable performance at low yearly cost.

CHOOSE FROM 3 COATING WEIGHTS

Crapo Galvanized Steel Strand is available in three weights of coating, Class A, B and C. Class B has twice the zinc by weight per square foot of wire surface as Class A; Class C has three times that of "A."

Contact the **Crapo** Galvanized Steel Strand distributor near you for prompt shipments from his stock or from our mill.

INDIANA
Steel & Wire Co., Inc.
Muncie, Indiana

gahela Power Co is **Victor L. Holt. Randall Leggett** succeeded **Ewing A. Johnson** as service manager. Johnson became engineering consultant.

British Columbia Electric Co has named **John Purves** general purchasing agent. He will succeed **Geoff Haszard** when Haszard retires in November. **Stu Jagger** was made stores manager.

General Electric Co has appointed **Edward M. Donegan** manager of materials, manufacturing in the insulating materials department. **F. W. McChesney** has retired as manager of industrial market development in the systems sales and engineering operation.

Gilbert R. Shockley has been named general director of Reynolds Metals Co's product development division.

Worthington Corp has promoted **Alfred H. Cercone** to manager of parts services in the marketing services group.

Robert S. Rogers has stepped into the position of manager of national accounts, large lamp products, for the lighting products division of Sylvania Electric Products Inc, subsidiary of General Telephone & Electronics Corp. Rogers succeeded the late **Raymond P. Connors.**

Minneapolis-Honeywell Regulator Co has appointed **Herbert J. Mulqueen** field sales manager for the electronic data processing division.

Allis-Chalmers Manufacturing Co has appointed **H. W. Cory** assistant general manager of the Norwood (Ohio) Works.

Royce C. Crawford, formerly electric utility sales manager for General Electric Co—St. Louis, has been named vice president of Todd-Atlantic Shipyards Corp's industrial products division.

New director of markets for P. R. Mallory & Co, Inc, is **William H. Starbuck.**

Fluor Corp, Ltd, has made **John H. Hemsarth** power division general manager.

Garry F. Simmons has stepped into the post of chief engineer of Precision Transformer Corp.

TURNER HUMES

Union Carbide Promotes Turner to Vice President

R. K. Turner has been elected a vice president of Union Carbide Corp. William B. Humes was named president of Union Carbide Plastics Co division.

Turner has been with the corporation since 1924. He has been Plastics Co division president since 1957.

With Union Carbide since 1944, Humes became a vice president of the Plastics Co division in 1959.

Olin Mathieson Chemical Makes Edgar Division VP

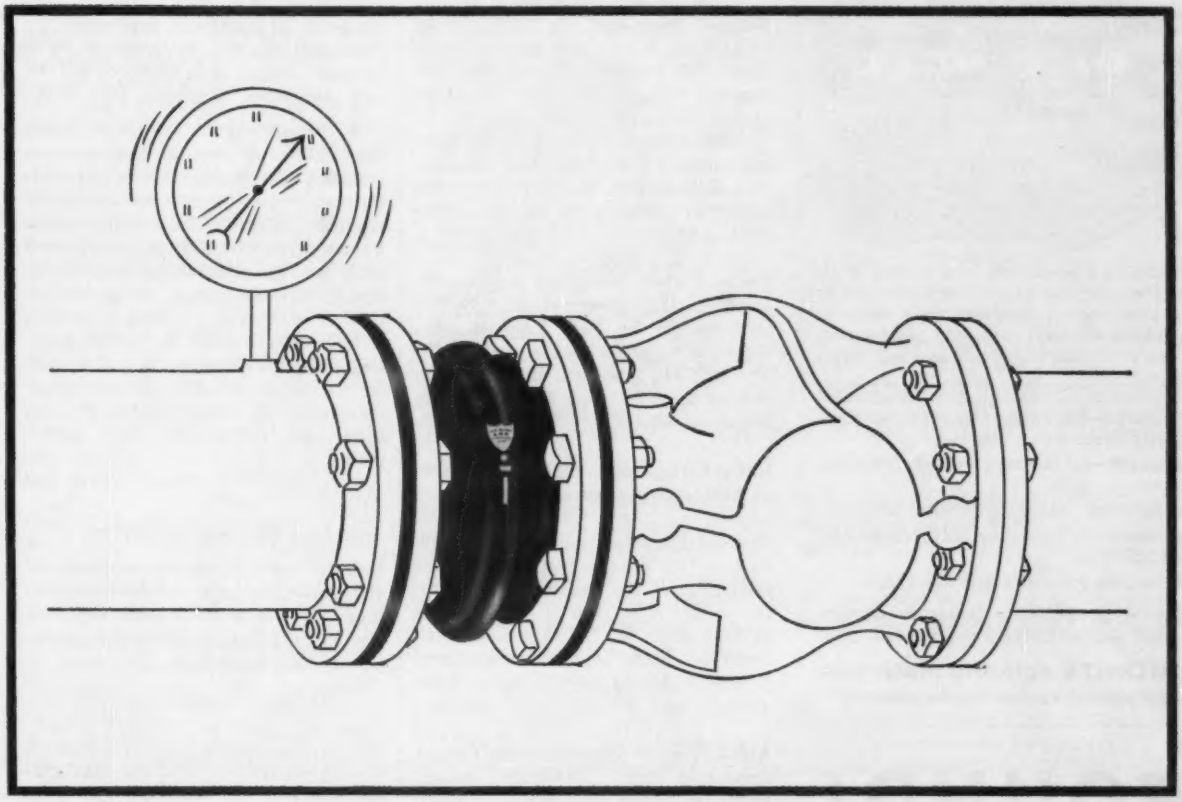
Fred H. Edgar has become division vice president - aluminum sales of the Olin Mathieson Chemical Corp metals division.

Simplex Names Prentiss Division General Manager

Simplex Wire & Cable Co has named Thomas M. Prentiss general manager of the submarine cable division at Newington, N.H.

(*More News About People on page* 68)

EXPANSION JOINTS



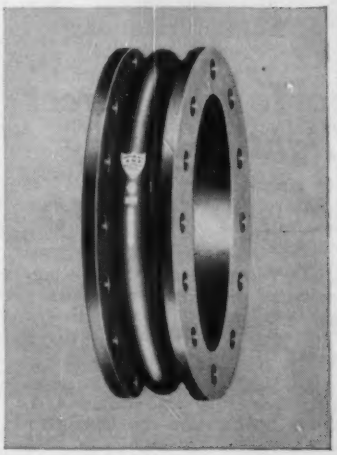
U.S. AMR Expansion Joints
handle even the highest surge pressures safely

Today's power and processing systems require piping that withstands flow surges, high pressures, and high temperatures unheard of a few years ago. Going hand in hand with improved piping is the simultaneous demand for better expansion joints.

U. S. Rubber . . . the company that brought you the *first* rubber expansion joint . . . now brings you the new AMR expansion joint, designed to meet today's most rigid requirements.

The AMR Expansion Joint:

- Has a new, patented inner construction with built-in *surge* protection for increased service life.
- Withstands higher continuous working pressures—pressures that exceed even the capacity of conventional wire-armored expansion joints.
- Has the flexibility of standard joints.
- Is available now in materials for handling corrosive chemicals and/or wide temperature ranges.



Your "U. S." representative will call at your request to give you the full facts and samples of this revolutionary development in rubber expansion joints. Why not call him . . . or write US at Rockefeller Center, New York 20, New York.

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

United States Rubber
MECHANICAL GOODS DIVISION

CABLE-MATCHED

OKOWELD dual-purpose tape is used for insulating and sheathing in one application up to 2000 volts . . . furnishes good dielectric strength, excellent flame and ozone resistance, withstands oil and chemical splashings.

Other cable-matched Okonite tapes:

OKONITE—for mineral-base rubber insulated cables.

OKOLITE—for oil-base rubber insulated cables.

OKOPRENE—neoprene blend for jacketing.

OKONEX—for insulating butyl splices and terminations.

MANSON—super-strong friction tape.

The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

OKONITE splicing materials

80 years of cable craftsmanship

FOUND!

How To Keep Street Lights Burning

Take a simple, lightweight, compact photo control. Use Varistors in conjunction with the secondary lightning arrester.

RESULT: You eliminate the one biggest cause of photo control failure... transient voltage surges which are *below* the spark-over of lightning arresters.

That's LUMATROL MARK I...completely reliable! It withstands ALL transients up through the capability of the secondary arrester!

WRITE FOR BULLETIN 91a.

MICRO BALANCING, INC.
GARDEN CITY PARK, N.Y.

In Canada: J. R. KEARNEY CORP.
Box 270, Guelph, Ont.

SALES ASSIGNMENTS

COMPANY STAFFS

James R. Kearney Corp has appointed Dean Cady West Coast regional manager. He operates out of the new regional office at 1299 Bayshore Highway, Burlingame, Calif. W. L. Manchester was named Kearney sales representative for the Los Angeles area, and Robert W. Mayers became sales representative for the San Francisco area.

Union Carbide Corp has assigned W. Kenneth Hill technical sales representative in the New England sales region of Union Carbide Plastics Co division. He is located in the Boston district sales office at 300 First Ave, Needham Hts.

Elliott Co has appointed Carl F. Harms as Minneapolis district manager.

General Electric Co has made Ralph E. Crockett manager of the Virginia sales district for the large lamp department. With district headquarters at Richmond, Va., Crockett replaced Dean N. Jenks who was transferred to Newton Upper Falls, Mass., as manager of New England sales district.

Allis-Chalmers Manufacturing Co has appointed the following: Joseph Bronaugh, utility sales manager, Baltimore district; Andrew Wassell, utility sales manager, Charlotte district; W. W. Chalmers, industrial sales manager, Charlotte district; Thomas L. Dineen, Cleveland district manager, Henry M. Brundage, Chattanooga district manager; J. Warren Roberts, Southeast regional representative for transmission and distribution equipment. He operates out of the region office in Atlanta.

Fanner Manufacturing Co has appointed Gordon D. Thorpe central area sales supervisor. He will provide closer liaison and service between factory and electric utilities through the company's representatives in 13 Midwestern states. He will operate out of Rockford, Ill.

I-T-E Circuit Breaker Co has named Albert L. Folden manager-commercial apparatus group for the Atlanta district office. He is responsible for promotion and sale in Georgia of the company's lighter equipment for the control and distribution of electric power. Richard L. Masterson was promoted to manager-commercial apparatus group for the New Haven district office.

Books

Technical Words Defined

Dictionary of Mechanical Engineering, by Alfred Del Vecchio. Published by Philosophical Library, 15 E 40 St, New York, N.Y. 346 pages, illustrated. Price $6.00.

This book contains about 3,000 definitions of words and phrases common in the fields of fuels and combustion, power plants, and automatic controls. Some of the definitions are quoted from publications of societies such as the American Society of Mechanical Engineers. Diagrams are used to explain terms, in a few cases.

The book is written for the practicing engineer and the skilled worker in the fields of architecture, automatic controls, engineering mechanics, fuels and combustion, and power plants.

Induction Heating Explained

Basics of Induction Heating, by Chester A. Tudbury. Published by John F. Rider Publisher, Inc, 116 W 14 St, New York, N.Y. 284 pages, 2 volumes, illustrated, paperbound. Price $3.90 each.

Fundamental principles and electrical and thermal aspects of induction heating, application of induction heating equipment, and the mechanical problems of fixturing are thoroughly and lucidly explained. Practical numerical examples useful to the daily needs of operators of induction heating equipment are used. A glossary of common terms is provided.

The book is useful to the engineer and operator of induction heating equipment, and possibly to the utility sales engineer dealing with users of induction heating equipment.

Machine Theory Explained

Electric Energy Conversion, by Y. H. Ku. Published by Ronald Press Co, 15 E 26 St, New York 10, N. Y. 522 pages, illustrated. Price $10.00.

Primarily a textbook for introductory courses in electrical machinery, this book discusses dc machines, transformers, synchronous and induction machines and includes one chapter on control types of dc generators such as Amplidynes and Rototrols. It provides a unified treatment of electrical machinery with emphasis on fundamental physical principles and on analytic techniques.

It can be useful to students and engineers working with motors and generators.

Error-Handling Outlined

Theories of Engineering Experimentation, by Hilbert Schenck Jr. Published by McGraw-Hill Book Co, 330 W 42 St, New York 36, N. Y. 239 pages, illustrated. Price $7.00.

For the laboratory and classroom, this book shows experimenters how to treat instrument and test equipment error. First, it shows how to lay out an experiment to minimize error, and second, it shows how statistically to determine the amount of error.

This book will help the part-time experimenter even more than the full-time experimenter. It presents methods which are numerically simple and easy to grasp. Two chapters, "Test Sequence and Experimental Plans" and "Test-Data Checking and Rejecting," illustrate the two main subjects in the book.

Engineers' Exams Detailed

Electrical Engineering for Professional Engineers' Examinations, by John D. Constance. Published by McGraw-Hill Book Co, 330 W 42 St, New York 36, N. Y. 448 pages, illustrated. Price $9.50.

This book will help to prepare a graduate engineer to pass the electrical engineering examination for professional engineer. Many problems from past examinations are presented; they are then explained and answered in detail, thereby providing a good understanding of the problem. The book is heavy on power equipment and light on electronics.

An understanding of the subject rather than a mere calculation of a problem is stressed. In this way, the engineer should be better prepared for problems that are rewritten from previous examinations.

Books Recently Received

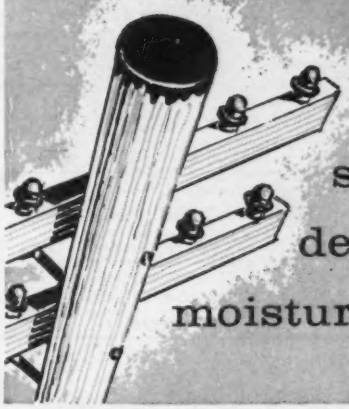
Oersted and the Discovery of Electromagnetism, by Bern Dibner. Published by Burndy Library, Norwalk, Conn. 48 pages. Price $2.00.

The President Makes a Decision, by Jason L. Finkle. Published by the Institute of Public Administration, University of Michigan, Ann Arbor, Mich. 204 pages. Price $3.50.

Foundation for Electric Network Theory, by Myril B. Reed. Published by Prentice Hall, Inc, Englewood Cliffs, N. J. 356 pages, illustrated. Price $13.00.

Line Waves and Antennas, by R. G. Brown, R. A. Sharpe, and W. L. Hughes. Published by Ronald Press Co, 15 E 26 St, New York 10, N. Y. 306 pages, illustrated. Price $10.00.

New CHAPMAN POL-KAP



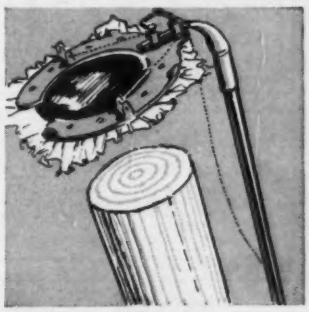
stops pole top decay...seals out moisture permanently

This new pole maintenance aid from Chapman Chemical Company is a pad of Chapman Pol-Nu preservative grease, which contains 10% pentachlorophenol, with the addition of a special mastic compound. When applied to a pole top the Pol-Kap adheres permanently, forming a uniform protective cover to seal out moisture. The penta solution is released into the wood to kill existing decay and prevent its recurrence.

Unique packaging—The Pol-Kap is prepared in a sealed, ready-to-use package made of a water-soluble (but oil insoluble) film which is dissolved by rainfall, leaving only the continuous smooth layer of permanent preservative grease on the pole roof.

Easily, safely applied with special Pol-Kap Applicator

This special applicator mounts on the end of a hot stick and enables a lineman to apply the Pol-Kap without having to climb above hot wires. It takes only a few seconds to position the preservative pad which forms a permanent protective covering that won't crack or check and can't be blown off pole top.



CHAPMAN CHEMICAL COMPANY
Leading manufacturer of wood preservatives
Memphis 1, Tennessee

CHAPMAN®
Pol-Kap

MAIL FOR COMPLETE INFORMATION
Chapman Chemical Company
P. O. Box 138, Memphis 1, Tenn.
Please send literature on the Pol-Kap to:

Name_____
Company_____
Address_____

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT: BUSINESS: **OPPORTUNITIES** EQUIPMENT: USED OR RESALE

DISPLAYED RATE: —RATES— **UNDISPLAYED RATE:**

EMPLOYMENT OPPORTUNITIES: $25.50 per inch. Subject to Agency Commission.

EQUIPMENT & BUSINESS OPPORTUNITIES: $16.85 per inch for all advertising appearing on other than a contract basis. Not subject to Agency Commission.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

$1.80 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $1.80 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

Send New Advertisements to Classified Advertising Div. of Electrical World, P. O. Box 12, N. Y. 36, N. Y.

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

• POSITIONS VACANT

Electrical Engineer, about 32, with 5 years experience in the electric distribution and transmission division, particularly familiar with construction and estimating with some selling experience. Location with Ohio Electrical Line Contractor. Please furnish detail experience and qualifications. P-6844, Electrical World.

Three Chief Operators with Public Utility experience for 80,000 KVA Hydroelectric Plant in East Pakistan. One year contract at $1000 per month with subsistance, housing and transportation furnished. All qualified applicants will be considered without regard to race, creed, color or national origin. Send resume of experience to Utah-Parkistan Inc., 221 Pine Street, San Francisco, California.

General Manager—For Ipswich Municipal Electric Department. Salary depends upon qualifications. KWH sales about 25,000,000 from our generating plant to 3000 consumers. Write to Personnel Department, Town Hall, Ipswich, Massachusetts for application and more details.

JOB ADVANCING?

Make the move to your new job easy and worry-free with the Burnham Van Personalized Moving Plan—the most helpful plan you ever saw.

Send for the free, 16-page booklet which gives you moving tips on how to pack, a checklist of things to do. Write for your copy today: Miss Mary Ellen Flynn,

BURNHAM VAN SERVICE
1633 Second Avenue, Columbus, Georgia

WHO'S WHO in—
Electrical Equipment Representatives
Write for free copy of EERA Directory
C. W. SWARD, Executive Director EERA
1675 Fifth St. Clermont, Florida

LARGE POWER EQUIPMENT
Prompt Stock Shipment
RENUBILT MOTORS - GENERATORS
TRANSFORMERS - CIRCUIT BREAKERS
DO YOU GET OUR STOCK LIST?
BELYEA COMPANY, INC.
51 Howell St. Jersey City, N. J.
OL-3-3334

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5636) will be received at Denver, Colorado, until 2 p.m. Mountain Standard Time, August 24, 1961, for furnishing generator-voltage bus structure, low-voltage feeder busways, and switchgear assemblies for Trinity Powerplant, Central Valley Project, California. Delivery is desired within 330 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner.

DON'T FORGET THE BOX NUMBER

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information and more products or better service—more value—to YOU.

PROFESSIONAL SERVICES

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction
Investigations, Valuations and Rates
1500 Meadow Lake Parkway
Kansas City 14, Missouri

CONSULT THESE SPECIALISTS
Let them save your time by bringing their broad experience in their specialty to bear on your problems.

PIONEER SERVICE & ENGINEERING CO.
Consulting & Design Engineers
Public Utilities—Industrials
Purchasing—Construction Management
231 So. La Salle St. Chicago 4

THEODORE D. BROSS LINE CONSTRUCTION CORP.
Steel Tower & Wood Transmission Lines
Distribution & Maintenance
175 Enfield St. Hartford, Conn.

JENSEN, BOWEN & FARRELL
Engineers
Appraisals—Depreciation Studies—Property Records
Cost Trends—Special Studies—Reports for Rate Cases, Security Issues, Regulatory and Accounting Requirements
Michigan Theatre Building Ann Arbor, Michigan
NOrmandy 8-7778

SANBORN MAP COMPANY, INC.
Nation Wide Mapping Services
• Utility Area Base Maps
• Symbolized System Portrayal
Atlanta - New York - Chicago - San Francisco

COMMONWEALTH SERVICES, INC.
Management and Business Consultants
300 Park Ave.
New York 22, N. Y.

ASSOCIATES, INC.
Consulting and Design Engineers
209 E. Washington
Jackson, Michigan

MINER AND MINER
Consulting Engineers
INCORPORATED
GREELEY, COLORADO
Littleton, Colorado
Tucson, Arizona Phoenix, Arizona

SARGENT & LUNDY
Engineers
Consultants to the Power Industry
STUDIES • DESIGN • SUPERVISION
140 South Dearborn Street, Chicago 3, Ill.

JASON ASSOCIATES
Consulting Wood Technologists
Field Inspection, Laboratory Assay, Utility Pole Records and Maintenance Programming. Acceptance Sampling of Utility Poles.
P. O. Box 42 Fort Collins, Colorado

MULTI-AMP DIVISION
MULTI-AMP ELECTRONIC CORPORATION
Designers • Engineers • Builders
Portable electric test equipment
Field and laboratory instruments; load boxes. For low voltage testing and calibrating of circuit breakers, protective and overload relays, reclosers, watt hour meters, fuse links.
63E Myrtle St. Cranford, N. J.

TIPPETT & GEE
Consulting Engineers
Mechanical • Electrical • Thermodynamic
Structural Design • Studies • Reports
Power Stations • Transmission • Distribution
Industrial Plants • Process
1223 North Second Street Abilene, Texas
314 Meadows Building Dallas, Texas

EMPLOYMENT OPPORTUNITIES

ENGINEER OVERSEAS

TRANSMISSION LINE AND SUBSTATION CONSTRUCTION

Interesting position for a graduate Electrical Engineer with a minimum of five years experience on transmission and substation construction. To supervise the construction of a 230KV line and the installation of 230 and 69KV substation equipment. Must have thorough knowledge of all phases of steel tower transmission line construction and the installation of substation equipment such as circuit breakers, shunt reactors, synchronous condensers, etc.

Salary commensurate with experience, plus overseas pay, completion bonus, living quarters furnished, liberal vacation policy and first class air travel.

Employment on 24 month contract; must pass physical examination.

Write fully, give detailed description of work experience, include salary information.

SVERDRUP & PARCEL
AND ASSOCIATES, INC.
915 Olive Street St. Louis 1,Mo.

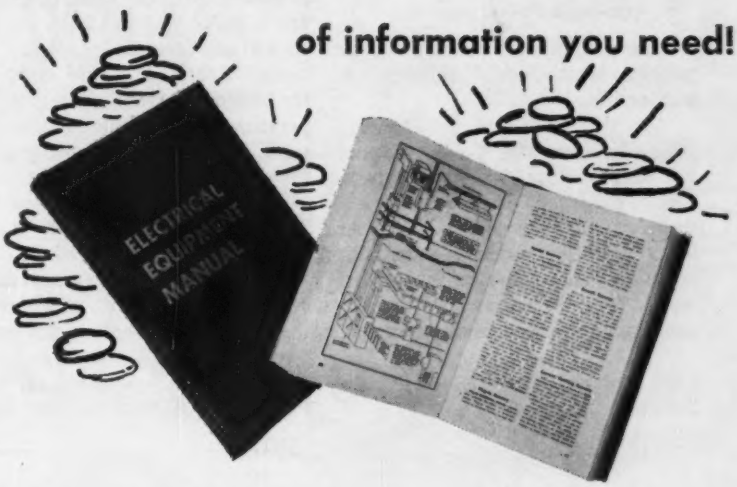
APPLICATION ENGINEER

For position in Marketing Department of prominent manufacturer of electric utility equipment. Must be system protection engineer with at least five years experience in the application of relays, circuit breakers, reclosers and fuses. Ability to communicate effectively is essential. Midwest location. Limited national travel. Send complete resume, recent picture and salary required.

Our employees know of this ad.

P-7068, Electrical World
645 N. Michigan Ave., Chicago 11, Ill.

A GOLD MINE . . .



Stake your claim for $4.50

ELECTRICAL EQUIPMENT MANUAL

Second Edition

by J. F. McPartland and W. J. Novak

Here's a 239-page, completely indexed, hard cover book. Everyday, easy-to-use data on

- Lamps
- Lighting Fixtures
- Air Conditioners
- Heaters
- Generators
- Sound Systems
- Motors
- Wire and Cable
- Transformers
- Capacitors
- Protective Devices
- Switchboards & Panelboards
- Motor Controls
- Wiring Devices
- Switches
- Relays
- Pole Line Equipment
- Raceways and Busways
- Insulating Materials
- Explosion-proof Equipment
- Batteries and Chargers
- Grounding Devices
- Time Switches
- Signals and Clock Systems
- Industrial Electronics
- Closed-circuit Television
- Tools
- Meters and Testers

Designed for use as an instruction manual or as a reference text . . . aimed at the practical interests of —

- Electrical Contractors
- Electricians
- Estimators
- Electrical Inspectors
- Consulting Engineers
- Plant Engineers

GET your copy today! The only book of its kind, it contains UP-TO-DATE installation and application data, highlighting the best of modern circuits in which equipment is used. This book guides you in selecting the right equipment and materials for every job. The unique format is designed to provide ready answers to specific questions.

Electrical Wholesaling
Dept. 270-059
330 West 42nd St.,
New York 36, N.Y.

Please send me_____copies of the sturdily-bound, 239-page book "Electrical Equipment Manual" at $4.50 per copy ($3.75 per copy for orders of 50 or more).
Enclosed is full payment of $_____

PLEASE PRINT

NAME_____

ADDRESS_____

CITY_____ STATE_____

COMPANY NAME AND ADDRESS_____

'Compact' Capacitors

(*Continued from page* 48)

electric system with no voids or air pockets which could shorten capacitor life.

Allis-Chalmers Mfg Co—A-C does not manufacture 100-kvar capacitors at this time. However, size reductions of their 50 and 25-kvar units were announced earlier this year — their 50-kvar capacitors weigh between 88 and 95 lb, depending on the voltage classification.

Line Material Industries—The new 50-kvar capacitor, featuring a reduction of weight from 91 to 70 lb, is now available. Tank dimensions are 4 in.X13½ in.X20¼ in. high. Important features of L-M's new capacitor are (1) liquid circulation for cooler internal operating temperature and, (2) improved tank design. New units will be available for shipment in a few weeks.

It is further reported that Line Material will also provide a 30% reduction in the weight of their 100-kvar unit and that, as a result of customer preference, it will retain the 15⅝-in. mounting dimension.

Ohio Brass Co—As of this past February, OB reduced the weight of their 50-kvar "Varex" units by 23% to 90 lb, to achieve at that time a reported "lowest over-all height of any standard available capacitor."

Sangamo Electric Co—Last fall Sangamo reported that the 100-kvar capacitors had been dropped to about 158 lb with their 50-kvar unit (4⅛X13½X23⅛ in.) reduced to 85 lb.

Westinghouse Electric Corp—About a year ago Westinghouse described their newest 100-kvar capacitor as weighing 193 lb, and having 6X20 X25¼-in. dimensions.

MANUFACTURERS BRIEFS

• **Standard Transformer Co,** div of American Gage & Machine Co, has announced its acquisition of 78,000 sq ft of manufacturing space on a three-acre site adjoining its Warren, Ohio, plant. New facilities are for distribution, small dry-type and small low-voltage-type instrument transformer production.

• **Dow Corning Corp's** hyper-pure silicon division has been established in new $2-million facilities in Hemlock, 15 miles south of DC's main plant in Midland, Mich. Dow believes this to be the "first fully integrated, high-purity silicon plant in the US using the Siemens process." Capacity is 25,000 lb of high-purity silicon per year. A process modified from information obtained from Westinghouse Electric Corp and Siemens-Schuckertwerke of West Germany is being employed.

• **Burndy Corp** and **Glass-Tite Industries, Inc,** have announced formation of Burndy-Escon, Inc—a company to be operated in Providence, R. I., by equal board representation of Burndy and Glass-Tite. G-T sold to Burndy a 50% interest in its wholly-owned subsidiary, Escon, Inc, manufacturer of high-temperature electrical and electronic connectors.

• **International General Electric Co** has been awarded a $4½-million order for packaged turbine-room equipment to supply power for a Yugoslavian industrial complex. A 130-Mw turbine-generator set, condenser, heaters, turbine-room piping and associated equipment for power station, as well as switchgear, transformers and an outdoor substation, are included in contract.

• **Anchor Metals Div of Electronic Specialty Co,** Hurst, Tex., has been awarded a $1.7 million order for the design, fabrication and production of electrical transmission towers for Texas Electric Service Co. It is reported that, through addition of Anchor last January, which was formerly a subsidiary of D. S. Kennedy Co, Electronic Specialty has become the United States' third largest producer of transmission towers,—behind US Steel and Bethlehem Steel.

Advertising Index

Allen-Bradley Co. 10
Allis-Chalmers Mfg. Co. 18, 19, 47
Anaconda Wire & Cable Co. 61
Anderson Electric Corp. 44, 45

Bethlehem Steel Co. 42

Chapman Chemical Co. 69

DeLaval Separator Co. 39
Directory of Engineers 70
Dravo Corp. 40, 41

Electrical Wholesaling 71
Engineers, Directory of 70

Fanner Mfg. Co. 49

G&W Electric Specialty Co. 64, 65

Hubbard & Company 60

Indiana Steel & Wire Co., Inc. 66

KPF Electric Co. 8, 9
Kaiser Aluminum & Chemical Corp. 16, 17
Kearney Corp., James R. ..... 2nd Cover
Kerite Company 22

Lapp Insulator Co., Inc. 6
Line Material Industries 15

Micro Balancing, Inc. 68

National Electric Coil Div. McGraw-Edison Co. 63

Ohio Brass Co. 51, 52
Okonite Co. 68

Pennsylvania Transformer Div. McGraw-Edison Co. ..... 4th Cover

Reliable Electric Co. ..... 3rd Cover
Rome Cable Div. of Alcoa 57

S&C Electric Co. 58, 59
Sangamo Electric Co. 20, 21
Searchlight Section 70

United States Rubber Co. 67
Uptegraff Mfg. Co., R. E. 4

Wheeler Mfg. Co.
Griscom-Russell Co. 7

PROFESSIONAL SERVICES 70

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES ... 71

EQUIPMENT
(Used or Surplus New)
For Sale 70

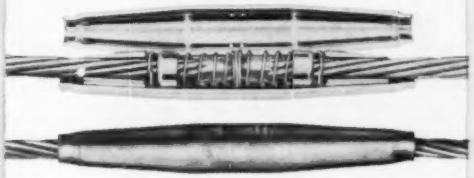
SPLICE and DEADEND

AAC, AAAC AND COPPER . . . WITH

RELIABLE "55" SERIES
PILOT CUP TYPE

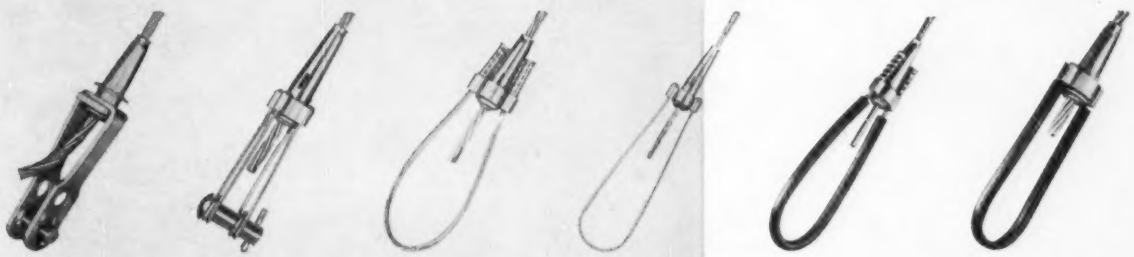
Pilot cup, factory installed in Reliable tension splices, either caps or refuses bent, out-of-lay or burred strand. The chuck cannot engage the conductor until the pilot cup, enclosing strand ends, has been run completely through the chuck. THUS ONLY SOUND CONDUCTOR IS POSITIONED WITHIN THE GRIPPING AREA.

Tensile tests prove the ability of these splices and deadends to hold 100% of the book rated strength of the conductor — AAC, AAAC or copper.



Catalog Number	AAC 7 Strand	AAAC 5005
AL5547	4	5
AL5527	2	3
AL55101	1	2
AL55107	1/0	1
AL55207	2/0	1/0
AL55307	3/0	2/0
AL55407	4/0	3/0
AL55266.8	266.8	4/0

FEED-THRU DEADENDS



"LINES UP"
Reliable's latest movie tells the whole story. Be sure to see it.

During twenty-seven years of continuing production it has never been reported that a Reliable Feed-Thru Deadend chuck let go a line

Reliable

ECTRIC COMPANY Franklin Park, Illinois

A Symbol of Integrity Since 1909

It took lots of planning to put these parts to work for you

by Gordon Wilson
CHIEF PLANNING ENGINEER
Pennsylvania Transformer Division

The dozens of items you see here are actual components of the direct-drive tap changer for Pole Star Distribution Regulators. One of the *simplest* LTC mechanisms in use today . . . it has an unsurpassed record for reliability in pole-top and station installations throughout the country.

It did not create itself, however. Thousands of man-hours (engineering, drafting, laboratory, machine shop, etc.) preceded patent applications and the first production order of this switch several years ago. Preliminary research, experimentation, testing... all were involved in our successful efforts to reduce the number of critical parts, and to assure utmost electrical and mechanical dependability.

Without such research-and-development efforts on the part of responsible manufacturers like Pennsylvania, there could be little progress in the electrical equipment field. And without significant improvements in equipment, America's light and power companies would be greatly handicapped in their own efforts at improving efficiency.

These are important things to remember in evaluating today's market conditions. It takes a healthy market to nourish R and D programs that in turn stimulate progress. The continuation of such programs is a matter of equal concern to manufacturers and purchasers of electrical equipment.

McGRAW-EDISON

PENNSYLVANIA TRANSFORMER DIVISION
McGRAW-EDISON COMPANY CANONSBURG, PA.